# RAIN/RIVER DATA LOGGER

# MODEL RRDL3-IMPERIAL

# OPERATION MANUAL

HYDROLOGICAL SERVICES Pty Ltd
48-50 Scrivener Street
Liverpool NSW 2170
Australia
Ph. 61 2 9601 2022 Fax. 61 2 9602 6971
E-Mail: sales@hydrologicalservices.com

# Table of Contents

Page


**1. Introduction** DL3 100-04 IMP

**2. Product Overview** DL3 100-05 IMP

**3. Installation** DL3 100-06 IMP

**3.1. Hardware Connections**

3.1.1 Tipping Bucket Raingauge DL3 100-06 IMP
3.1.2 River Sensor DL3 100-07 IMP
3.1.3 Communications DL3 100-08 IMP
3.1.4 DIP Switches DL3 100-09 IMP

**3.2. Setup and Configuring the Logger** DL3 100-10 IMP

3.2.1 Site Information DL3 100-10 IMP
3.2.2 System Time/Date DL3 100-10 IMP
3.2.3 Rainfall Sensor + Parameters DL3 100-10 IMP
3.2.4 Quadrature River Sensor + Parameters DL3 100-11 IMP
3.2.5 Analog River Sensor 4-20mA + Parameters DL3 100-11 IMP
3.2.6 Communications DL3 100-12 IMP

**4. Operation** DL3 100-13 IMP

**4.1. Commands / Syntax** DL3 100-13 IMP

4.1.1 On line help (?) DL3 100-13 IMP
4.1.2 Alarms (AL, CLA, DUA, RALx, RVALx) DL3 100-14 IMP
4.1.3 Battery Voltage (BV) DL3 100-19 IMP
4.1.4 Bye (BYE) DL3 100-19 IMP
4.1.5 Call/Clear Sequence/Numbers (CALLx, CLEARx, CNx) DL3 100-19 IMP
4.1.6 Communications (COM, SEND, EV, RE, RETRY) DL3 100-21 IMP
4.1.7 Date/Time Parameters (D, T, TO) DL3 100-23 IMP
4.1.8 Dump Log (DUR, CLR, DURV, CLRV, LOG) DL3 100-24 IMP
4.1.9 Miscellaneous (ID, SI,MO, PASSWD, RESET, VER) DL3 100-26 IMP
4.1.10 Rain Parameters (RCHID, RI) DL3 100-27 IMP
4.1.11 River Parameters Quad (RVCHID, RVI, RVHR) DL3 100-28 IMP
4.1.12 River Parameters 4-20mA(RVI, RVHR, TXR, TXI) DL3 100-28 IMP
4.1.13 Status (ST, COM, R, RV) DL3 100-30 IMP
4.1.13.1 The Status Window DL3 100-30 IMP
4.1.13.2 The Communications Window DL3 100-32 IMP
4.1.13.3 The Rainfall Message DL3 100-33 IMP
4.1.13.4 The River Height Message DL3 100-34 IMP
4.1.13.5 Water level (WL) DL3 100-35 IMP

**4.2. Data Output Format** DL3 100-35 IMP

4.2.1 Rainfall Record DL3 100-35 IMP
4.2.2 River Height Record DL3 100-36 IMP

**Table of Contents cont'd**

Page

**5. Specification** DL3 100-38 IMP
**5.1. Hardware Specifications** DL3 100-38 IMP
5.1.1 General DL3 100-38 IMP
5.1.2 Rainfall Sensor Interface DL3 100-39 IMP
5.1.3 River Height Sensor Interface DL3 100-39 IMP
5.1.4 Communication Interface DL3 100-40 IMP
5.1.5 Watchdog DL3 100-40 IMP
5.1.6 Power Supply / Power Consumption DL3 100-40 IMP
5.1.7 System Memory DL3 100-41 IMP
5.1.8 System Clock DL3 100-41 IMP
5.1.9 Logger Identification DL3 100-41 IMP
5.1.10 Start-up Indicator DL3 100-41 IMP
5.1.11 Transient, EMI, RFI Protection DL3 100-41 IMP

**6. Fault Finding** DL3 100-43 IMP

# APPENDIX A

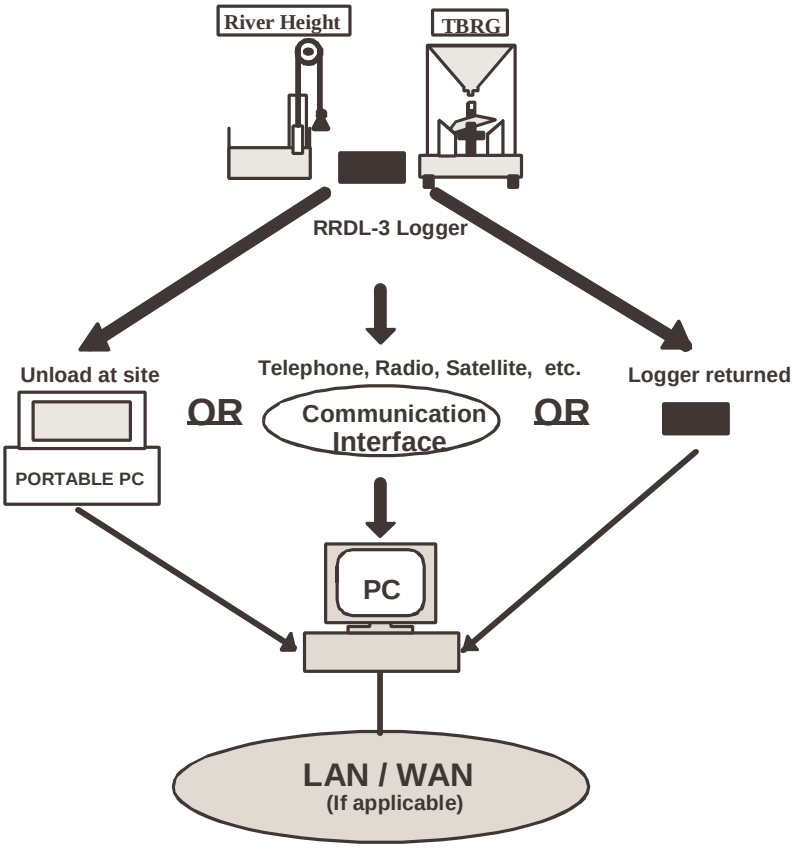
**RRDL-3 Communication Software (Operation Manual)** DL312 100-01 IMP
1 Introduction DL312 100-03 IMP
2 Hardware Connection DL312 100-03 IMP
3 Software Installation DL312 100-04 IMP
4 Starting and Configuring the Software DL312 100-04 IMP
5 Saving data to a file DL312 100-05 IMP
6 Saving logger output in Spreadsheet format DL312 100-06 IMP
7 Exiting the program DL312 100-06 IMP

# APPENDIX B

**Description of Software** DL3 AB 100-01
1 Introduction DL3 AB 100-02
2 Version 3.00 DL3 AB 100-03
3 Version 3.10 DL3 AB 100-04
4 Version 3.11 DL3 AB 100-05
5 Version 3.50 DL3 AB 100-06
6 Version 4.00 DL3 AB 100-06

# 1. Introduction

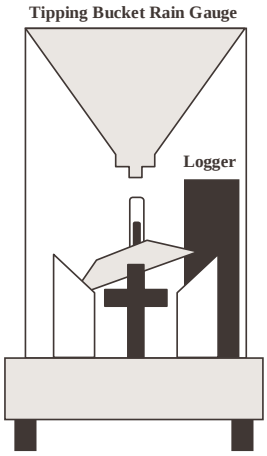
The Hydrological Services Rain and River Data Logger RRDL-3 has been designed using surface mount technology to provide a very small, low power and reliable data logger that can be used in harsh environments for extended periods. Flash memory technology has not only been used for data storage but also for program storage - which provides secure non-volatile data storage as well as the unique capability of remote software download as new software features and revisions become available. The logger can be connected to a standard Tipping Bucket Rain Gauge as well as either a Quadrature River Height Sensor or 4-20mA River Height Pressure Transducer. The communication features allow for very flexible operation either directly connected to a computer or through a communication modem (wired, cellular, radio or satellite). The logger can be set up to dial out to several separate computer networks when preprogrammed alarm thresholds are reached or at periodic preprogrammed times. The unique on-board help feature allows the user to obtain a description, as well as syntax and examples, of any of the 59 commands.



# 2. Product Overview

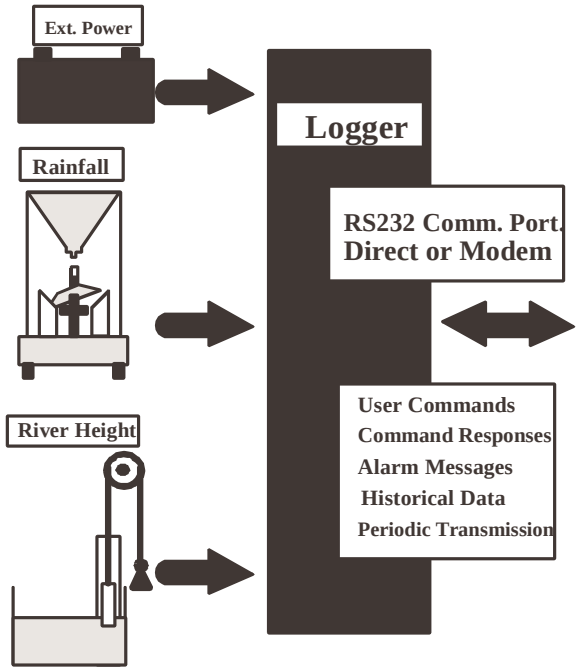
## 2.1 Overview

The Hydrological Services Rain and River Data Logger unit (shown right as a black box) is easily installed within a standard Tipping Bucket Rain Gauge, (TBRG). Rain falling on the collecting funnel is directed through a siphon control unit and discharges as a steady stream into a two compartment bucket mounted in unstable equilibrium. As each compartment fills, the bucket tilts alternately about its axis.




Each tip forces a contact closure of a magnetic reed switch corresponding to 0.01 inch of rainfall, (Bucket Capacity = 0.01 inch). The logger unit accepts the contact closure and records the event as a time stamp to one second resolution. Each event is stored in secure, non-volatile flash memory in preparation for data extraction. The logger unit can either be removed from the TBRG for data retrieval while a fresh replacement logger is fitted to continue the rainfall record, or a communication medium such as telephone modem, cellular phone modem, radio modem or satellite modem may be connected to the logger for periodic data extraction as well as alarm monitoring.

The data extraction process is accomplished via an IBM/AT personal computer or similar. A simple connection is made between the PC and logger to allow data retrieval upon operator command. The data format of the logger file is specified within this document.




The RRDL-3 can also be connected directly to a quadrature river height sensor or a 4-20mA pressure transducer (through an optional analog interface). The logger is event triggered when interfaced to the quadrature sensor, and time period triggered with the analog pressure transducer. Each event is stored in secure, non-volatile flash memory in preparation for data extraction. When the logger is event triggered and not connected to an external communication service, it spends most of its life in a powered downstate and therefore consumes very little power - and may run for up to one year on its internal batteries.

# 3. Installation

## 3.1 Hardware Connections

The external connections to the RRDL-3 varies depending on the user configuration.

- Tipping Bucket Rain Gauge (TBRG).
- Quadrature or 4-20mA River Height Sensor.
- Standalone, direct connect communications to a PC or communications to a PC through a modem.
- Internal or external batteries.

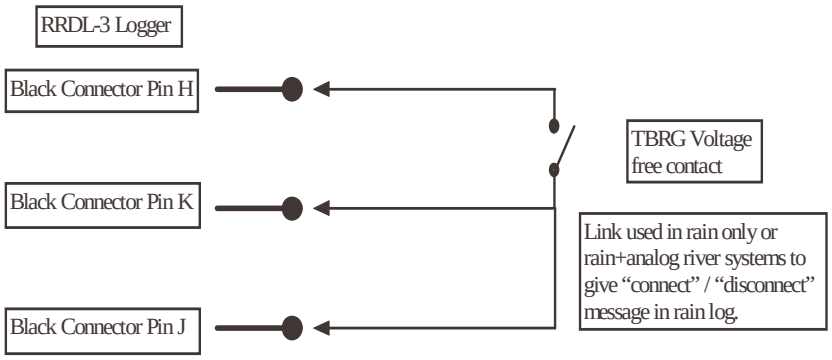
The 10 pin connector with the black marking on the logger is setup as follows :-

***Optional External Smart Sensor + Internal Batteries***

| Pin Connection | Signal Name |
|---|---|
| A | Smart Sensor Isolated Tx |
| B | Smart Sensor Isolated Rx |
| C | Smart Sensor Isolated Gnd |
| D | Not Connected |
| E | Not Connected |
| F | Ext. Sensor Control (Not Implemented) |
| H | Bucket Tip |
| J | Quadrature A |
| K | Digital Sensor Gnd |
| L | Quadrature B |

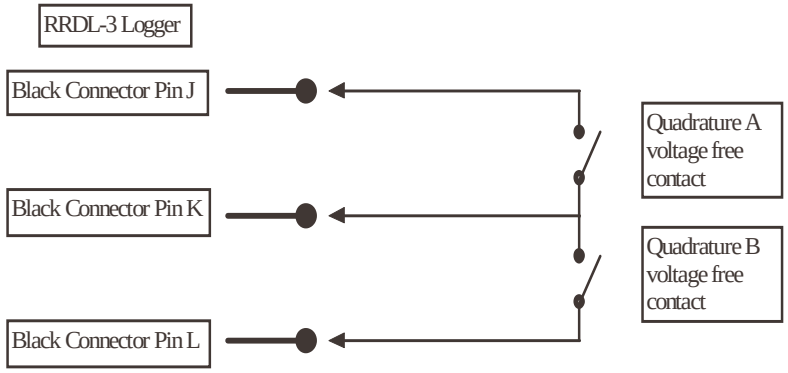
### 3.1.1 Tipping Bucket Rain Gauge (TBRG)

***Connection of Tipping Bucket Rain Gauge (TBRG)***

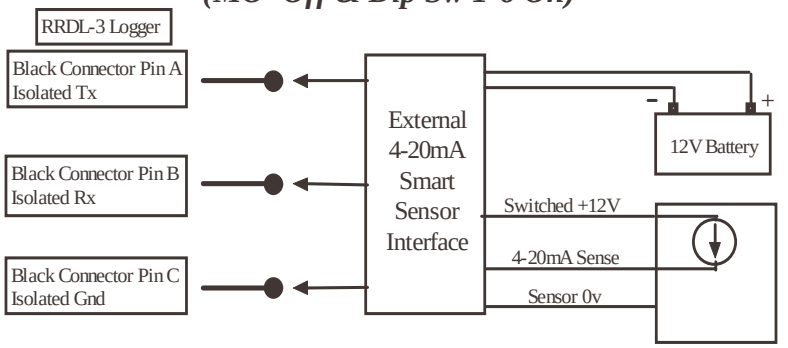

RRDL-3 Logger
Black Connector Pin H
Black Connector Pin K
Black Connector Pin J
TBRG Voltage free contact
Link used in rain only or rain+analog river systems to give "connect" / "disconnect" message in rain log.

## 3.1.2 River Sensor

***Connection of Quadrature River Sensor (MO=Off & Dip Sw 1-6 Off)***


RRDL-3 Logger
Black Connector Pin J
Black Connector Pin K
Black Connector Pin L
Quadrature A voltage free contact
Quadrature B voltage free contact

***Connection of 4-20mA River Transducer with External Smart Sensor (MO=Off & Dip Sw 1-6 On)***

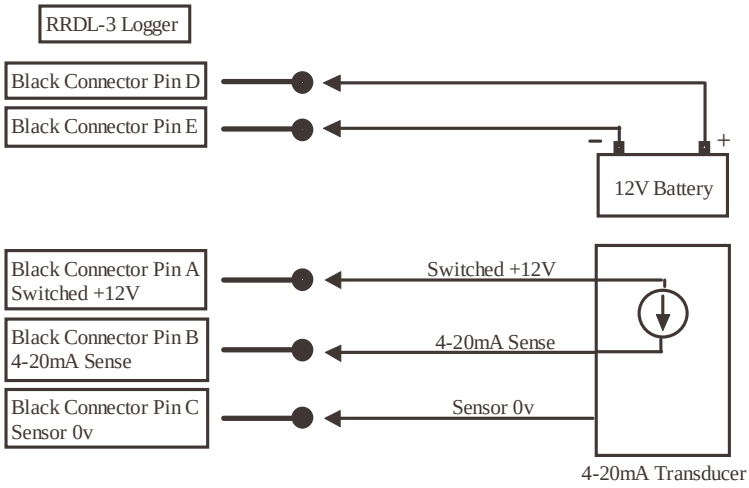



* Pinc C not used for 2-wire systems

***Optional Internal Smart Sensor + External Batteries***
***(Note: Internal Smart Sensor interface physically replaces the internal battery pack)***

| Pin Connection | Signal Name |
|---|---|
| A | 4-20mA Transducer switched +12V |
| B | 4-20mA Transducer In |
| C | 4-20mA Transducer Gnd |
| D | Power 12v |
| E | Power 0v |
| F | Ext. Sensor Control (Not Implemented) |
| H | Bucket Tip |
| J | Quadrature A |
| K | Digital Sensor Gnd |
| L | Quadrature B |

***Connection of 4-20mA River Transducer with Internal Smart Sensor (MO=Off & Dip Sw On)***



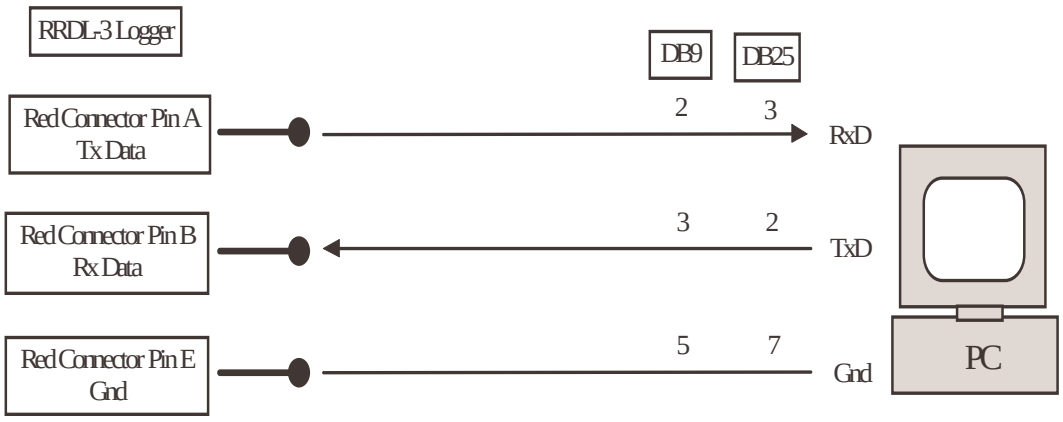

* Pinc C not used for 2-wire systems

## 3.1.3 Communications

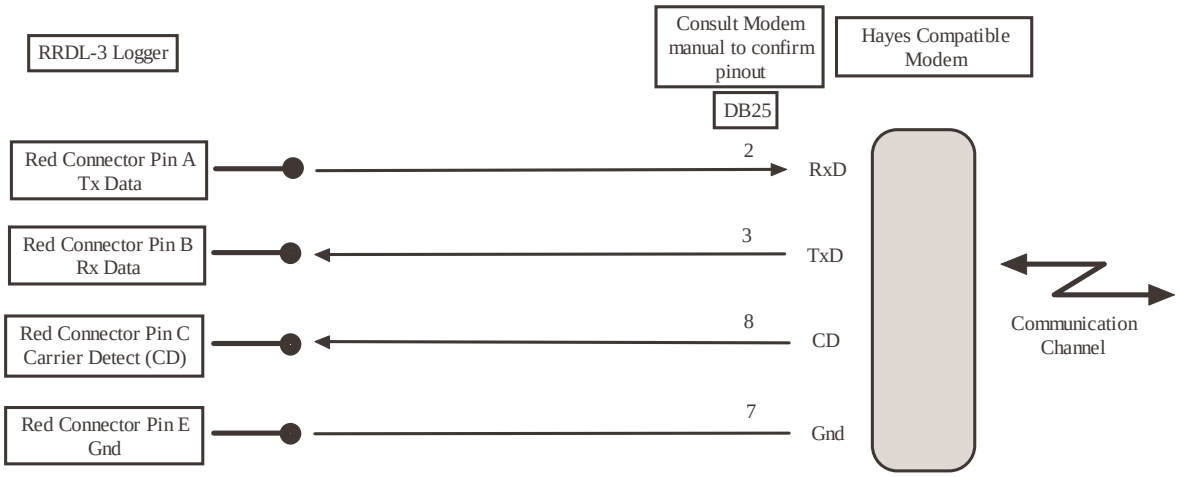
The 7 pin connector with the red marking on the logger is the communications port and is setup as follows:-

| Pin Connection | Signal Name |
|---|---|
| A | Tx Data (Output from logger) |
| B | Rx Data (Input to logger) |
| C | Carrier Detect (Input to logger) |
| D | Not Connected |
| E | Not Connected |
| F | Modem Power (Not Implemented) |
| H | Gnd |

***Direct connection to a PC (Handshake = Xon/Xoff)***



***Connection to a PC through a modem (Handshake = Xon/Xoff)***




## 3.1.4 DIP Switches

To obtain access to the DIP switches, first remove the cover of the RRDL-3 logger, then carefully remove the battery pack, being careful not to damage the foam seal that isolates the batteries from the electronics. The DIP switch should be visible with the individual switch numbers being printed on the switch itself as well as the text "OFF" on one side of the switch.

| Baud Rate | Dip Sw 1-1 | Dip Sw 1-2 |
|---|---|---|
| 300 | Off | Off |
| 1200 | On | Off |
| 9600 | On | On |

| DIP Switch | Off | On |
|---|---|---|
| Sw 1-3 | No Handshake | Handshake Enabled |
| Sw 1-4 | Xon / Xoff Handshake | Hardware Handshake |
| Sw 1-5 | Go to sleep in 1 minute | Go to sleep in 5 minutes |
| Sw 1-6 | River is Quadrature | River is 4-20mA |
| Sw 1-7 | 8 bits / No parity / 1 stop bit | 7 bits / Even Parity / 1 stop bit |
| Sw 1-8 | Not Used | Not Used |

Notes :

- Sw 1-4 is only active if handshake is enabled by Sw1-3.
- Xon/Xoff handshake is recommended.
- Sw 1-6 is only active if the software switch MO is set to off (Rain + River mode).
- Switches are read continuously and therefore may be changed while the logger is powered

## 3.2 Setup and Configuring the Logger

Once the RRDL-3 logger has been connected to a computer, the parameters can be setup using a 'dumb' terminal emulation program. The program should be set for the appropriate baud rate, parity and handshake, the same as the logger Dip Sw settings, as well as for "local echo on". On receipt of individual commands from the computer, the logger will respond with the current parameter setting. (Note that the command keywords permit both upper and lower case characters, or a combination of both.) A carriage return ( < CR > ,↵ , Enter Key) immediately following an entry will action the command. Invalid entries return a "Command Error" response. A list of all logger commands may be viewed on the computer screen by using the unique on-board help system. Simply type ? . Further help on a command can be obtained by typing the command and then a question mark and then pressing the Enter key.

Data and parameter security is provided by means of a user password. Any data or parameters may be viewed without a password, but parameters may only be altered and data may only be cleared after the password has been entered correctly. Parameters may be entered by typing the command then the equals symbol (=) and then the new parameter and then the Enter key.

### 3.2.1 Site Information

The "Site Information" (SI) is a user definable 16 character string that allows each logger to have a unique location name. Alternatively, loggers in a locality may be given the same name and the rainfall or river channel ID may be used to uniquely identify the loggers data. This allows for easy identification of dumped data or status window information. See section 4.1.9. for more information on this command.

### 3.2.2 System Time/Date

The "Time" (T) and "Date" (D) as well as "Time Offset" (TO) should be checked for accuracy during installation. Note that the time and date are maintained and updated in the logger independent of whether the logger is powered or not. (This is provided by a real time clock circuit powered by an internal lithium battery with a minimum life of 10 years) The time offset provides a means by which loggers scattered throughout different time zones may be referenced to a common time zone, which becomes important when the data from the loggers is gathered and processed at one location.

Hardware Time + Time Offset = Software Time/Date

Note: Events are time stamped to hardware time, messages are time stamped and generated at software time (If TO=00:00 then Software Time/Date = Hardware Time/Date) See section 4.1.7. for more information on these commands.

### 3.2.3 Rainfall Sensor + Parameters

The rainfall sensor or TBRG has several parameters that allow characterisation of the sensor being used as well as alarm criteria that will be specific to the location that the sensor. The "Rainfall Channel ID" (RCHID) is a 7 digit user definable number that should be set to uniquely set to identifythe rainfall channel. The "Rainfall Increment" (RI) parameter defines the bucket capacity

of the specific TBRG used as well as the number of tips that defines one rainfall event - this determines the resolution and the rate at which flash memory is used. See section 4.1.10. for more information on these commands.

Three separate "Rainfall Alarms" (RAL1, RAL2, RAL3) may be programmed in a logger that has a communication path to a computer. An alarm will cause the logger to perform a certain sequence (defined by the CALL, CALL NUMBER, and CLEAR parameters) that will dial out through a modem to a computer and send a rainfall request message. Rainfall alarm 1 (RAL1) is a threshold alarm that is triggered when the rainfall since 09:00 exceeds the RAL1 parameter. Rainfall alarms 2 and 3 (RAL2, RAL3) are rate of rain alarms that monitor the amount of rain in a defined period. Note that the master alarm flag must be enabled (AL=on) before alarm checking is performed. See section 4.1.2. for more information on these commands.

When a quadrature sensor is *not* being used, a link between the Quad A input and Gnd will allow two separate events to be logged into the rainfall log ("Connect" and "Disconnect") that will occur when the plug that is connected into the black marked socket is removed or plugged in. This allows an event to be logged during routine maintenance of the TBRG, without the need for extra equipment.

### 3.2.4 Quadrature River Sensor + Parameters

The quadrature river height sensor has several parameters that allow characterisation of the sensor being used as well as alarm criteria that will be specific to the location that the sensor. The "River Channel ID" (RVCHID) is a 7 digit user definable number that should be set to uniquely set to identify the river channel. The "River Increment" (RVI) parameter defines the actual mechanical or electrical resolution expressed as millimetres of river height as well as a multiplier. The "River Height Reference" (RVHR) is the height from which the river height data is referenced. (ie. The river height as read from a staff gage during routine calibration) See section 4.1.12. for more information on these commands.

Three separate "River Alarms" (RVAL1, RVAL2, RVAL3) may be programmed in a logger that has a communication path to a computer. An alarm will cause the logger to perform a certain sequence (defined by the CALL, CALL NUMBER, and CLEAR parameters) that will dial out through a modem to a computer and send a river request message. River alarm 1 and 2 (RVAL1, RVAL2) are threshold alarms that are triggered when the river height exceeds the RVAL1 or RVAL2 parameters. Rainfall alarm 3 (RVAL3) is a rate of river change alarm that monitors the rise or fall of a river in a defined period. Note that the master alarm flag must be enabled (AL=on) before alarm checking is performed. See section 4.1.2. for more information on these commands.

### 3.2.5 Analog River Sensor 4-20mA + Parameters

The analog 4-20mA river height transducer has several parameters that allow characterisation of the transducer being used as well as alarm criteria that will be specific to the location that the transducer. The "River Channel ID" (RVCHID) is a 7 digit user definable number that should be set to uniquelyset to identify the river channel. The "Transducer Reference" (TXR) parameter defines the 20mA depth expressed in metres of water. The "Transducer Interval" (TXI) parameter defines the frequency that analog measurements are made as well as the time that the transducer

is powered before a measurement is made. The "River Increment" (RVI) parameter defines the river height recording increment resolution expressed in millimetres. The "River Height Reference" (RVHR) is an offset that is added to the river height as measured by the transducer alone. See section 4.1.12. for more information on these commands.

Three separate "River Alarms" (RVAL1, RVAL2, RVAL3) may be programmed in a logger that has a communication path to a computer. An alarm will cause the logger to perform a certain sequence (defined by the CALL, CALL NUMBER, and CLEAR parameters) that will dial out through a modem to a computer and send a river request message. River alarm 1 and 2 (RVAL1, RVAL2) are threshold alarms that are triggered when the river height exceeds the RVAL1 or RVAL2 parameters. Rainfall alarm 3 (RVAL3) is a rate of river change alarm that monitors the rise or fall of a river in a defined period. Note that the master alarm flag must be enabled (AL=on) before alarm checking is performed. See section 4.1.2. for more information on these commands.

### 3.2.6 Communications

The logger has an RS232 serial interface to support asynchronous ASCII communications to accommodate data extraction and user set-up. This port operates at 300, 1200, and 9600 baud with either no parity, 8 data bits and 1 stop bit or even parity, 7 data bits and 1 stop bit selectable via dip switches. The communication port supports software flow control, Xon/Xoff protocol and the standard RS232 handshake and control signals. The communication sequence to a modem can be customised by use of the CALL and CLEAR sequences. See section 4.1.5.

Message transmission may be initiated from the logger by an automatic calling feature (see the "SEND" command in section 4.1.6) or via preset rain and river alarms (RALx, RVALx) or via a user polling sequence. Several destinations may be automatically called by using the programmable call numbers (CN1, CN2, CN3). If a destination is "busy" when a logger calls out, several attempts may be programmed by using the retry (RETRY) parameter.

When an intelligent modem is used with the logger it is important to turn off responses (RE=off) so that logger messages such as "Command Error" , "Going to Sleep", "Waking Up" and "CR LF" do not cause the modem to issue a reply, which will cause the logger to reply, which will cause the modem to reply, etc...

Each rainfall and river event that is logged is also transmitted on the serial port, unless the event output flag is off (EV=off). This flag should be off when the logger is connected to an intelligent modem.

# 4. Operation

## 4.1 Commands / Syntax

Each of the logger commands that follow are described in detail and include the exact On-line Help information that is provided in the RRDL-3 logger by entering Comnd? ↩

### 4.1.1 On-line Help (?)

A list of all logger commands and abbreviated syntax is given when ?↩ is sent to the logger. For more information on any specific command enter Comnd? ↩

***On-line Help***

```
? ↩
Data Logger Command Syntax
==========================                                  [...] = optional to set
parameter
(Command may be upper and/or lower case)        <CR>  = press carriage return
AL[=on/off]<CR>          (en/disable Alarms)      BV<CR>                          (Batt. Voltage)
BYE<CR>                  (Go to Sleep)            CALLx[=30char]<CR>   (Call Seq. x=1,2,3,4)
CLA<CR>                  (CLear Alarm log)        CLEARx[=30chr]<CR>   (Clear Psychs=1,2,3,4)
CLA<CR>                  (Clear Rain log)         CLRV<CR>             (CLear RiVer log)
CNx[=12 dig]<CR>         (Call No x=1,2,3)        COM<CR>              (COMms window)
D[=mm/dd/yy]<CR>         (Date)                   DUA<CR>              (DUmp Alarm log)
DUR[...]<CR>             (DUmp Rain log)          DURV[...]<CR>        (DUmp RiVer log)
EV[=On/Off]<CR>          (EVent output)           ID<CR>               (logger ID)
LOG[=On/Off]<CR>         (En/Disable Log)         MO[=On/Off]<CR>      (Mode rain Only)
MW[=On/Off]<CR>           (Memory Wrap)           PASSWD=****<CR>       (4 char password)
PASSWD=****<CR>           (4 char password)       R<CR>                 (Rainfall request)
RALx[=...]<CR>           (Rain ALarm x=1,2,3)     RE[=On/Off]<CR>      (REsponse output)
RESET<CR>                 (software RESET)        RETRY[=1 dig]<CR>    (comms RETRY cnt)
RCHID[=7 dig]<CR>        (Rainfall CH ID)         RI[=x.x/mm]<CR>      (Rainfall Inc.)
RV<CR>                    (River request)         RVALx[=...]<CR>       (RiV. ALarm x=1,2,3)
RVCHID[=7 dig]<CR>       (RiVer CH ID)            RVHR[=xx.xxx]<CR>    (RiV. Height Ref(m))
RVI[=xx/mm]<CR>          (RiVer lvl Inc)          SEND[=hh/m/tt]<CR>   (mesg SEND schedule)
SI[=16chars]<CR>          (SIte name)             ST<CR>                (STatus window)
T[=hh:mm:ss]<CR>          (Time)                  TO[=hh:mm]<CR>        (Time Offset)
TXI[=mm/s]<CR>           (Trans Interval)         TXR[=xx.x]<CR>       (Trans 20mA depth)
VER<CR>                   (S/W Version)

FOR MORE INFO TYPE COMND?<CR> (or call Hydrological Services on 61-29-601-2022)
```

## 4.1.2 Alarms (AL, CLA, DUA, RALx, RVALx)

Alarm messages are generated when rainfall and river height conditions meet user defined alarm criteria. An alarm will cause the following sequence of events to occur:-

1. An alarm message is constructed at the time of the alarm and saved.
2. A CLEAR sequence is performed to get the modem into a known state.
3. A CALL sequence is performed to cause the modem to dial a phone number. (If "N" appears in the CALL sequence then a CALL NUMBER is substituted)
4. After a successful connection the previously constructed Rain or River alarm message is transmitted. Unsuccessful connection will cause a 60 sec timeout and then return to step 2. (This will reoccur depending on the value of RETRY)
5. A CLEAR sequence is performed again to get the modem back into a known state.
6. If there is more than one CALL NUMBER defined then return to step 2.

The logger retains a historical log of twelve alarm messages. As a new alarm is generated, the log file is updated with the new message while the oldest message within the log is discarded. A dump of the alarm log always provides the twelve most recent alarms in the order they were generated with the most recent message first.

The alarm flag enables or disables all alarm checking. Each of the 3 Rain and 3 River alarms may also be enabled or disabled individually. (See RALx and RVALx in this section)

***On-line Help***

AL? ↵
Alarm On/Off: En or dis the alarm checking (rain & river)
Syntax: AL<CR> Displays current alarm checking state
AL=ON<CR> En
AL=OFF<CR>Dis

***On-line Help***

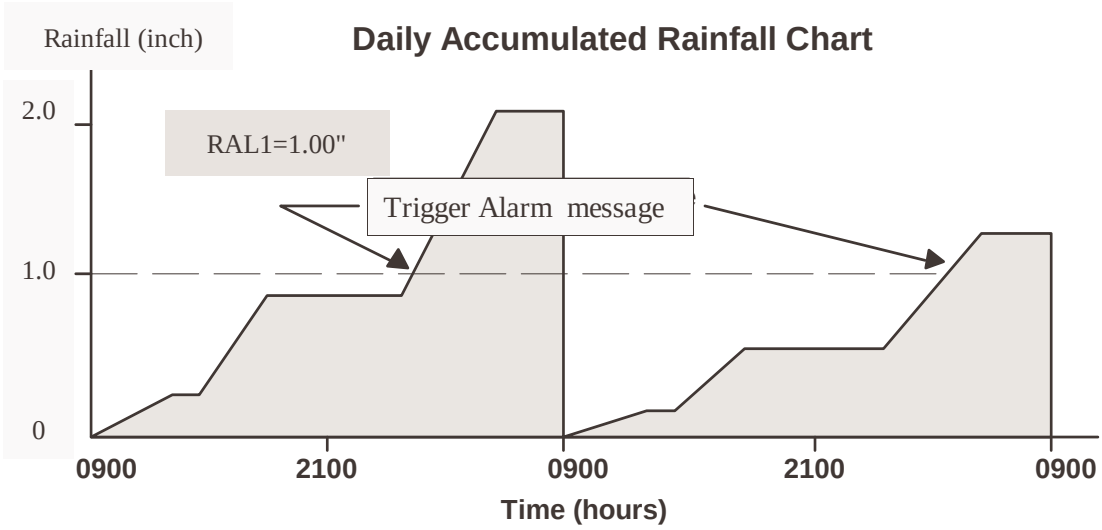
DUA? ↵
Dump Alarm Log: Dumps Time, Date & Alarm type of last 12 alarms
Syntax: DUA<CR>

***On-line Help***

CLA? ↵
Clear Alarm Log: Totally erases the alarm log
Syntax: CLA<CR> (OK when complete)

**Rainfall Alarm 1 (Ral1)**

Rainfall Alarm 1 is a simple threshold type alarm. Once conditions meet the alarm criterion for RAl1, ( Rainfall since 0900 greater than RAl1 value) the alarm sequence is generated sending the rainfall message and the alarm condition is reset until 0900 the following day. The alarm condition can only occur once within a 24 hour period between 0900 and 0900 unless the alarm threshold for RAl1 has been re-defined by user command.



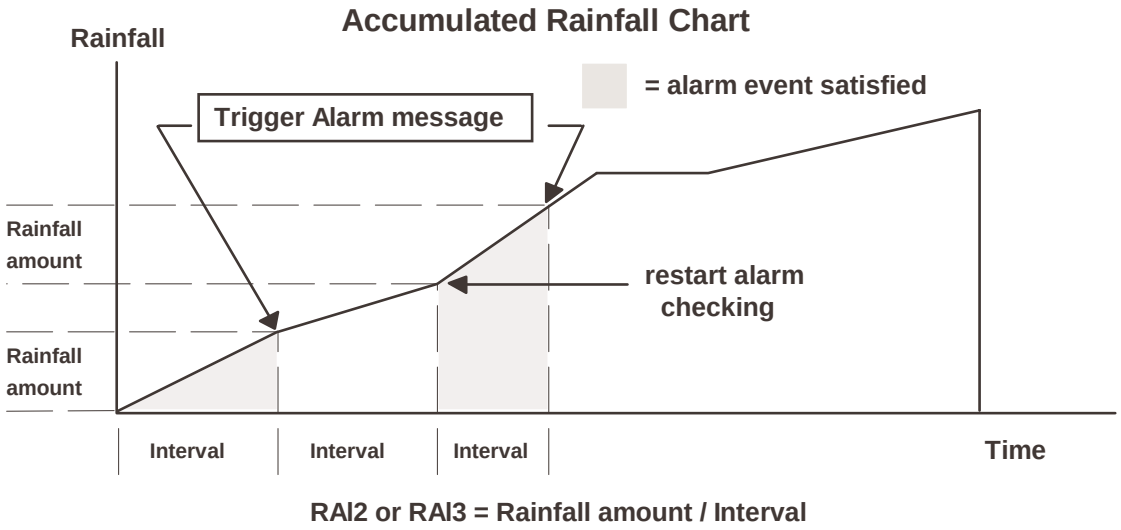

The rainfall alarm 1 can be individually disabled by entering RAL1= ↩ When the alarm is disabled the alarm value is displayed as "--.-"

***On-line Help***

| | |
|---|---|
| RAL1? ↩ | |
| Rainfall Alarm 1: | If the rainfall since 0:900 is> RAL1 then an alm mesg is generated if alm checking is enabled |
| Syntax: RAL1<CR> | Displays RAL1 threshold in inch |
| RAL1=1.00<CR> | Sets RAL1 to 1.00" |

**Rainfall Alarm 2 and Rainfall Alarm 3 (RAl2 & RAl3)**

Rainfall Alarm 2 and 3 are rate of increase alarms. Alarm conditions for RAl2 and RAl3 are checked after each rainfall event against the user defined criteria for rainfall amounts over some time interval. Once conditions are satisfied, an alarm sequence is generated sending the rainfall message. The alarm event , RAl2 or RAl3, is then disabled for a period of time as defined by the interval duration of the alarm parameter after which time alarm checking for the appropriate alarm condition continues. If the alarm conditions RAl2 or RAl3 are re-defined by user command, then alarm checking recommences immediately.




The rainfall alarm 2 and 3 can be individually disabled by entering RAL2=↵ or RAL3=↵ When the alarm is disabled the alarm value is displayed as "--.-/--:--"

***On-line Help***

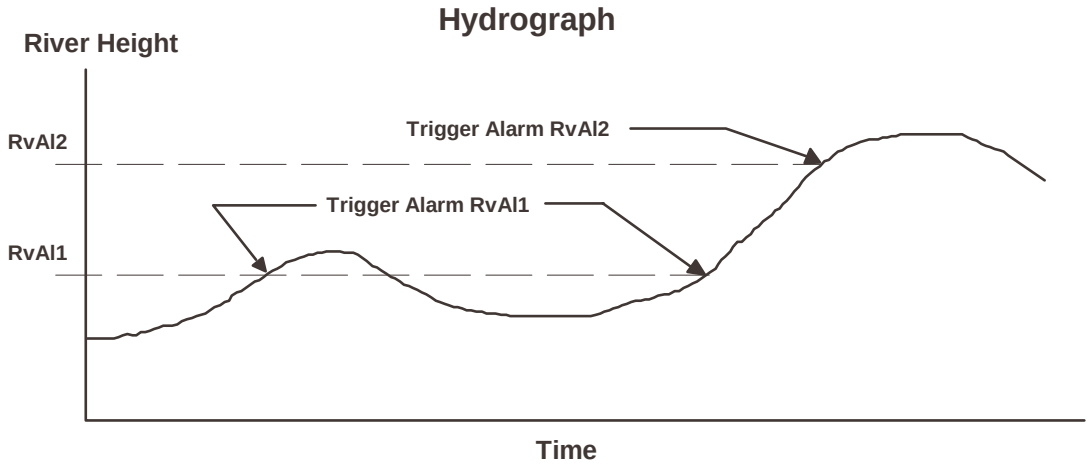
| | |
|---|---|
| RAL2? ↵ | |
| Rainfall Alarm 2: | If the rainfall amount in the given time interval is exceeded then an alm mesg is generated if alm checking is enabled |
| Syntax: RAL2<CR> | Displays RAL2 value in inch/Hr:min |
| RAL2=0.79/02:30<CR> | Sets RAL2 to 0.79" over last 2.5hrs |

***On-line Help***

| | |
|---|---|
| RAL3? ↵ | |
| Rainfall Alarm 3: | Same alarm criteria & syntax as RAL2 |

**River Alarm 1 and River Alarm 2 (RvAl1 & RvAl2)**

River Alarms 1 and 2 are threshold type alarms. When the river height rises to a level as defined by RvAl1 or RvAl2, an alarm sequence is generated sending the river message. Successive alarms of the same type can only occur if the river height falls below the defined threshold of RvAl1 or RvAl2 and rises again to satisfy the alarm criteria or if the criteria are re-defined by user command.




The river alarms 1 and 2 can be individually disabled by entering RVAL1= ↵ or RVAL2=↵ When the alarm is disabled the alarm value is displayed as "--.--"

***On-line Help***

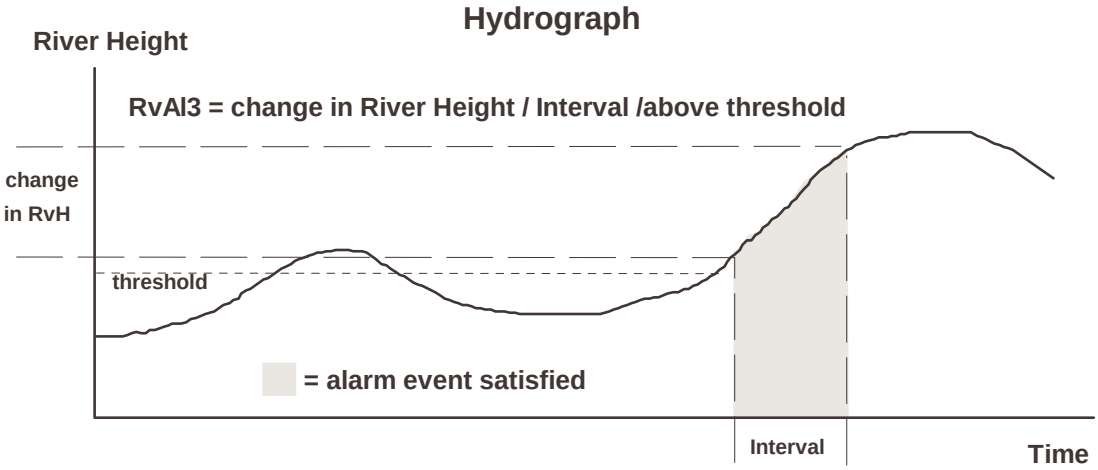
| |
|---|
| RVAL1? ↵ |
| River Alarm 1: If the river height is > RVAL1 value then an alm mesg is generated if alm checking is en |
| Syntax: RVAL1<CR> Displays RVAL2 values in feet |
| RVAL1=007.00<CR> Sets threshold to 7 ′ |

***On-line Help***

| |
|---|
| RVAL2? ↵ |
| River Alarm 2: Same alarm criteria & syntax as River alarm 1 |

**River Alarm 3 (RvAl3)**

River Alarm 3 is a rate of change alarm. Alarm checking for RvAl3 will commence once the river rises above a user defined threshold. Above this threshold an absolute change in river height over a defined time interval as specified by RvAl3 interval parameter, will trigger an RvAl3 event. Alarm checking for an RvAl3 condition is then disabled for a period of time equivalent to half the interval parameter of RvAl3 (interval/2). Alarm checking then recommences immediately after this interval or if RvAl3 parameters have been re-defined by user command.




**Note: RvAl3 may occur as the river is falling since the alarm criteria is for absolute change.**

River alarm 3 can be individually disabled by entering RVAL3=↵ When the alarm is disabled the alarm value is displayed as "--.--/--:--/--.--"

***On-line Help***

| |
|---|
| RVAL3?↵ |
| River Alarm 3: If the river changes at a rate > RVAL3 then an alm mesg is generated, if the river is above user defined threshold and alm checking is en |
| yntax: RVAL3<CR> Displays RVAL3 value in feet per time interval (Hr:min) + the river threshold in metres |
| RVAL3=003.00/02:30/005.50<CR> Sets parameter to a height change of 3 ′ over the last 2.5 hrs if the river height is > 5.5′ |

### 4.1.3 Battery Voltage (BV)

The RRDL-3 logger battery voltage is measured and displayed when the battery voltage command (BV) is executed as well as during a status window command (ST), a rain message (R), a river message (RV), and when any alarm occurs that generates a rain or river message.

***On-line Help***

| |
|---|
| BV? ↩ |
| Battery Voltage: Reads logger supply voltage to one decimal point |
| Syntax: BV<CR> |

### 4.1.4 Bye (BYE)

The RRDL-3 logger has two distinct modes of operation. When the logger is 'awake' it consumes approximately 75mA and responds to external commands and events instantly. When the logger is 'asleep' it consumes approximately 200uA and is awaiting to be woken up by one of several external events :- a TBRG bucket tip, a river quadrature input change, reception of serial data, a carrier detect change of state, a timer wakeup from the real time clock. Note that when the logger is woken up by serial data, the character that wakes up the logger is lost! Therefore a character such as Carriage Return should be used to wake up the logger before a command is sent. The logger will then stay awake until it receives a BYE command or the programmed Go to Sleep time of 1 or 5 minutes is exceeded. When the logger is woken by one of the other external events it performs appropriate action and then goes back to sleep to conserve power.

The BYE command is used to force the logger to go to sleep to conserve battery power as well as break command access so the password must be entered to action a parameter change next time the logger is woken.

***On-line Help***

| |
|---|
| BYE? ↩ |
| Bye: Forces logger to go to sleep & breaks command access |

### 4.1.5 Call/Clear Sequence/Numbers (CLEARx, CALLx, CNx)

These programmable dialogues are used to control an external modem. The clear sequence gets the modem into a known state and the call sequence initiates a call through the modem. Both the call and clear sequences send commands to the modem and wait for a response. The call and clear sequence is performed if an alarm occurs or if a scheduled send command is programmed. The following sequence of events will occur:-

1. An rain or river message is constructed and saved.
2. A CLEAR sequence is performed to get the modem into a known state.
3. A CALL sequence is performed to cause the modem to dial a phone number. (If "N" appears in the CALL sequence then a CALL NUMBER is substituted)
4. After a successful connection the previously constructed Rain or River message is transmitted. Unsuccessful connection will cause a 60 sec timeout and then return to step 2. (This will reoccur depending on the value of RETRY)

5. A CLEAR sequence is performed again to get the modem back into a known state.
6. If there is more than one CALL NUMBER defined then return to step 2.

***On-line Help***

CLEAR1? ↩
Clear1/2/3/4 Sequence Programmable string dialogue for terminating a comms call after transmission of an alarm or scheduled mesg. Sequence of up to 4 command strings with opt response to clear a call via an external comms I/F (Max 30 chars/seq)(~ = 0.5S pause; ^ = CTL char)
Syntax: CLEAR1<CR> Displays clear seq1
(Similar for CLEAR2, CLEAR3 & CLEAR4)
CLEAR1=+++~~ATH/OK<CR> Sets the clear seq 1
(Note: CLEAR1=Command Sent/Expected Response)

***On-line Help***

CALL1? ↩
Call1/2/3/4 Sequence Programmable string dialogue for establishing a comms call prior to an alarm or scheduled mesg Sequence of up to four command strings with opt response used when calling a remote host via an external comms I/F (Max 30 chars/seq)(~ = 0.5S pause; ^ = CTL char)
Syntax: CALL1<CR> Displays call seq
(Similar for CALL2, CALL3 & CALL4)
CALL1=ATDT036694154^M~/CONNECT<CR> Sets the call seq1
(Note: CALL1=Command Sent/Expected Response)

***On-line Help***

CN1? ↩
Call Numbers 1/2/3: User programmable phone nos. 3 unique no.s represented by the string "N" and placed in the call seq for mesg transfer to 1 or more dest. (CN1, CN2 & CN3 = 3 dest (Max 12 dig ea)
Syntax: CN1<CR> Displays call no1 (Blank => Not Used)
CN1=036694154<CR>Sets call no 1 (Similar for 2 & 3)

## 4.1.6 Communications (COM, SEND, EV, RE, RETRY)

The communications of the RRDL-3 logger is set up by a combination of DIP switches and software flags. The configuration of all logger communications parameters is displayed in the comms window. (See section 3.1.4. for DIP switch setup)

***On-line Help***

| | |
|---|---|
| COM? ↵ | |
| Comms Window: | Returns a summary of comms setup details |
| Syntax: COM<CR> | |

***Command Example***

| | | | |
|---|---|---|---|
| COM ↵ | | | |
| Site(SI): | MELB | LoggerID(ID): | HS0012 |
| Date(D): | 03/29/94 | Baud Rate {S1-1,S1-2}: | 9600 |
| Time(T): | 03:09:03 | Bits/parity/stop {S1-7}: | 8/N/1 |
| Time Offset(TO): | 00:00 | Handshake {S1-3,S1-4}: | Xon/Xoff |
| Call Number 1(CN1): | 036694154 | Response On/Off(Re): | On |
| Call Number 2(CN2): | 036694158 | Communication retries(RETRY): | 3 |
| Call Number 3(CN3): | | Message Scheduling (SEND): | 09/5/01 |
| Call1: | +++~~~ATQ0^M/^M^JOK | Clear1: | ~~+++~~~~ATQ0H^M^M^JOK |
| Call2: | ~~ATDT"N"^M/^M^JCO | Clear2: | ~~ATQ1^M~~~ |
| Call3: | | Clear3: | |
| Call4: | | Clear4: | |

The SEND command allows the programming of scheduled rain and river messages at regular intervals. The SEND parameter comprises three parts, the frequency of transmission in whole hours from midnight, an offset in minutes from the scheduled interval and the number of transmission cycles in a 24 hour period. (Note that the offset allows many loggers in a network to record the status on the hour, and dial through to a central computer at staggered times to alleviate the communication bottleneck)

***On-line Help***

| | |
|---|---|
| SEND? ↵ | |
| Send: | Allows scheduled transmission of rainfall & river height mesg at specified intervals (hh/m/tt) hh=hourly interval; m=minute offset; tt=no. of times |
| Syntax: SEND<CR> | Displays send command |
| SEND=03/4/05<CR> | Transmit a rain & river message at 03:04, 06:04, 09:04, 12:04 and 15:04 |

As events occur they are transmitted on the serial port. A rain event is transmitted as a time, and a river event is transmitted as a time and river height. When an intelligent modem is connected to a logger it is undesirable for this to occur, so events may be turned off by using the event flag. (Note that when the event flag is off the power consumption will be improved, as the logger will wake up for a shorter period of time when an event occurs)

***On-line Help***

| | |
|---|---|
| EV? ↵ | |
| Event Output On/Off: | En or dis event time stamps (rain & river) being sent to the comms port |
| Syntax: EV<CR> | Displays event output state |
| EV=ON<CR> En | |
| EV=OFF<CR> | Dis |

When a logger is connected to an intelligent modem and the modem outputs a response that the logger does not recognise, the logger will reply with "COMMAND ERROR" which may cause the modem to respond etc..... This is undesirable, so the responses from the logger can be disabled by turning off the response flag.

***On-line Help***

| | |
|---|---|
| RE? ↵ | |
| Response Output On/Off: | En or dis "COMMAND ERROR" + 'Going to sleep' + 'Waking up' responses to the comms port |
| Syntax: RE<CR> | Displays response output state |
| RE=ON<CR> | En |
| RE=OFF<CR> | Dis |

When a logger dials out onto a communication network, there is no guarantee that it will be able to successfully connect to the required destination (it may not be able to get a line or the line may be busy) The logger will then wait 60 seconds and try again. The number of times it retries depends on the RETRY variable.

***On-line Help***

| | |
|---|---|
| RETRY? ↵ | |
| Comms retry: | Specifies the number of comms retries should a comms call fail (60 sec between retries) |
| Syntax: RETRY<CR> | Displays retry count |
| RETRY=3<CR> | Sets retries to 3 |

## 4.1.7 Date/Time Parameters (D, T, TO)

The logger date and time is maintained in a battery backed Real Time Clock whose time base is adjustable by a trim capacitor on the circuit board. Time is displayed in 24 hour format separated by colons, and the date is displayed as day/month/year with slash separators. When entering the time and date all fields must be entered. Note that if the time is entered as T= then it will be reset to midnight 00:00:00.

***On-line Help***

| | |
|---|---|
| T? ↵ | |
| Time: | Use 24 hour time format with colon separator |
| Syntax: T<CR> | Displays hardware time |
| T=9:45:0<CR> | Sets the time (Note: Leading 0's are optional but |
| T=16:25:26<CR> | hrs+mins +secs must be entered) |

***On-line Help***

| | |
|---|---|
| D? ↵ | |
| Date: | Use Mn/Dy/Yr format with slash separator |
| Syntax: D<CR> | Displays hardware date |
| D=3/4/92<CR> | Sets date (Note: Leading 0's are optional but |
| D=10/25/92<CR> | mo+day+yr must be entered) |

The Time Offset parameter allows data from loggers in different time zones to be synchronised to a reference time zone location. If this feature is not required then simply set the time offset to 00:00.

***On-line Help***

| | |
|---|---|
| TO? ↵ | |
| Time Offset: | Hardware Time + Time Offset = Software Time/Date |
| | Note: Events are time stamped to H/W time, |
| | mesg time stamped at S/W time |
| | (If TO=00:00 then S/W Time/Date = H/W Time/Date) |
| Syntax: TO<CR> | Displays the current Time Offset |
| TO=09:30<CR> | Sets the Time Offset parameter (Note: Leading 0's |
| | must be entered) |

## 4.1.8 Dump Log (DUR, CLR, DURV, CLRV, LOG)

The loggers rain and river log data is stored in a compressed format in the on-board flash memory. The dump rainfall command (DUR) unloads the historical rainfall record from the start of the record to the most recent event stored. On completion of successful data retrieval, the memory remains intact until cleared by the clear rain log user command (CLR). When the memory becomes full, with Memory Wrap off, the logger stops logging and tacks a "Mem Full" message onto the end of an event message. The rainfall log may be dumped in ascii or hex format. The ascii format is readable (as shown in section 4.2.1.) and the hex format must be interpreted by separate software which converts it to ascii format. The hex format has the advantage that the data is still compressed and will download faster. The dump command also allows for searching through the log and starting at a specific location instead of dumping the complete log. See the On-line help below for syntax and see section 4.2.1. for an example of the dumped rainfall record.

A new command, Memory Wrap (MW), enables or disables the wrapping of memory. When memory wrap is on, and the historical log becomes full, then the first data stored will be erased one block at a time. (A block of Flash memory is equivalent to approximately 8100 rain events, or 8100 quadrature river events or 4050 4-20mA river events.) In this mode memory never becomes full, and the most recent data is always available. It is advisable that when changing the state of the Memory Wrap flag, the existing logged data be erased so that logging can start afresh.

***On-line Help***

DUR? ↵

Dump Rainfall Log: Dumps historical data from the start to the most recent event stored. NOTE: Time/Date referenced to H/W clock

Syntax: DUR/format/No of days/Time/Date<CR>

Format=A(ascii) or H(hex) No of days=1-99

Time=hh:mm Date=mm/dd/yy

Parameters from L to R are opt - See manual for details

Eg. DUR<CR> Dump all rainfall data in ascii

DUR/H<CR> Dump all rainfall data in hex

DUR/A/12/10:45/12/2/96<CR> Dump 12 days of ascii data starting at 10:45 on the 2nd of Dec 1996

More Eg. DUR/A<CR>Dump all rainfall data in ascii

DUR/A/2<CR> Dump 2 full days of ascii data starting 2 days back from the current date, at 00:00 hours

DUR/A/1/13:40<CR> Dump 1 day of ascii data starting at 13:40 today

DUR/A/2/10:30/3<CR> Dump 2 days of ascii data starting at 10:30 on the 3rd of the current month & year

DUR/H/15/10:30/2/12<CR> Dump 15 days of hex data starting at 10:30 on the 12th of Feb this year

***On-line help***

| | |
|---|---|
| CLR? ↩ | |
| Clear Rainfall Log: | Totally erases the rainfall log |
| Syntax: CLA<CR> | (OK when complete) |

The dump river command (DURV) unloads the historical river record from the start of the record to the most recent event stored. On completion of successful data retrieval, the memory remains intact until cleared by the clear river log user command (CLRV). When the memory becomes full, the logger stops logging and tacks a "Mem Full" message onto the end of an event message. The river log may be dumped in ascii or hex format. The ascii format is readable (as shown in section 4.2.2.) and the hex format must be interpreted by separate software which converts it to ascii format. The hex format has the advantage that the data is still compressed and will download faster. The dump command also allows for searching through the log and starting at a specific location instead of dumping the complete log. See the DUR On-line help for syntax and see section 4.2.2. for an example of the dumped river record.

***On-line Help***

| | |
|---|---|
| DURV? ↩ | |
| Dump River Height Log: | Dumps historical data from the start to the most recent event stored |
| Syntax: DURV/format/No of days/Time/Date<CR> | |
| (** SEE "DUR?" HELP FOR SYNTAX EXAMPLES **) | |

***On-line Help***

| | |
|---|---|
| CLRV? ↩ | |
| Clear River Height Log: | Totally erases river height log |
| Syntax: CLRV<CR> | (OK when complete) |

Logging to memory may be turned on and off using the log flag. This is used when a site needs to be tested but the existing log should not be disturbed. As the flag is turned on or off, an event is stored in the rain and river log that indicates the time of "Logging Disabled" and "Logging Enabled" for future reference. See the river log example in section 4.2.2.

***On-line Help***

| | |
|---|---|
| LOG? ↩ | |
| Logging On/Off: | En or dis logging to memory. Used when testing a station, events still reported through serial port |
| Syntax: LOG<CR> | Displays log state |
| LOG=ON<CR> | En |
| LOG=OFF<CR> | Dis |

A new command, Memory Wrap (MW), enables or disables the wrapping of memory. When memory wrap is on, and the historical log becomes full, then the first data stored will be erased one block at a time. (A block of Flash memory is equivalent to approximately 8100 rain events, or 8100 quadrature river events or 4050 4-20mA river events.) In this mode memory never becomes full, and

the most recent data is always available. It is advisable that when changing the state of the Memory Wrap flag, the existing logged data be erased so that logging can start afresh.

***On-line Help***

| | |
|---|---|
| MW? ↩ | |
| Memory Wrap: | Allows rain & river log to wrap around |
| | Erase logged data when changing this flag ! |
| Syntax: MW<R> or MW=ON<CR> or MW=OFF<CR> | |

## 4.1.9 Miscellaneous (ID, SI, MO, PASSWD, RESET, VER)

The logger ID is set at time of manufacture and can only be read.

***On-line Help***

| | |
|---|---|
| ID? ↩ | |
| Logger ID String: | Display manufacturer ID with embedded logger serial no. |
| Syntax: ID<CR> | eg. HS0001 |

The site name variable is used to either identify a specific logger or the location of the logger. The user can use this field for whatever they wish.

***On-line Help***

| | |
|---|---|
| SI? ↩ | |
| Site Name: | Variable length to 16 chars |
| | (alphanumeric upper & lower case) |
| Syntax: SI<CR> | Displays the site name |
| SI=Melb<CR> | Sets site name |

The Mode Rain Only flag is used to select whether the logger is used for logging rainfall only or for logging rain + river data. (Note the hardware DIP switch 1-6 selects river quadrature or river 4-20mA transducer)

***On-line Help***

| | |
|---|---|
| MO? ↩ | |
| Mode Rain Only: | Parameter to set ‘Rain Only’ or ‘Rain + River’ modes |
| Syntax: MO<CR> | Displays Mode Rain Only state |
| MO=ON<CR> | Set Rain Only |
| MO=OFF<CR> | Set Rain + River |

The password prevents unauthorised access to altering the parameters or clearing the rain and river logs. Password access is cleared when the logger "Goes to Sleep" either due to the "BYE" command being entered or the 1 or 5 minute timeout elapsing. New passwords may be entered by first gaining access, and then entering the password command again with the new password. Note that the password is upper / lower case sensitive.

***On-line Help***

| | |
|---|---|
| PASSWD? ↩ | |
| Password: | Four character passwd to allow user access |
| | to alter parameters or change existing passwd |
| | NOTE: Upper/lower case sensitive |
| Syntax: PASSWD=****<CR> | To attempt access, or change password if access |
| | already accepted |

The reset command performs a hardware reset, but does not affect the time, date, parameters or logged data.

***On-line Help***

| | |
|---|---|
| RESET? ↩ | |
| Reset: | Performs a reset of the logger. Note this command |
| | is equiv to switching logger off-on again |
| Syntax: RESET<CR> | |

***On-line Help***

| | |
|---|---|
| VER? ↩ | |
| Software Version: | |
| Syntax: VER<CR> | Displays the software revision and date |

## 4.1.10 Rain Parameters (RCHID, RI)

The "Rainfall Channel ID" (RCHID) is a 7 digit user definable number that should be set to uniquely set to identify the rainfall.

***On-line Help***

| | |
|---|---|
| RCHID? ↩ | |
| Rain Channel ID: | Fixed length 7 digit numeric field |
| Syntax: RCHID<CR> | Displays rain ch ID |
| RCHID=0012345<CR> | Sets RCHID to 0012345 |

The "Rainfall Increment" (RI) parameter defines the bucket capacity of the specific TBRG used as well as the number of tips that defines one rainfall event - this determines the resolution and the rate at which flash memory is used.

***On-line Help***

| | |
|---|---|
| RI? ↩ | |
| Rain Increment: | Defines water volume that constitutes recorded |
| | rainfall event. Bucket capacity in inch x recording mult |
| Syntax: RI<CR> | Displays the rainfall inc parameter |
| RI=0.01/02<CR> | Defines bucket size as 0.01″ capacity & a mult |
| | of 2 => 0.02″ of rain is one event |

## 4.1.11 River Parameters Quadrature (RVCHID, RVI, RVHR)

The "River Channel ID" (RVCHID) is a 7 digit user definable number that should be set to uniquely set to identify the river channel.

***On-line Help***

| | |
|---|---|
| RVCHID? ↩ | |
| River Channel ID: | Fixed length 7 digit numeric field |
| Syntax: RVCHID<CR> | Display river ch ID |
| RVCHID=0567890<CR> | Sets 'RVCHID' to 0567890 |

The "River Increment" (RVI) parameter defines the actual mechanical or electrical resolution expressed as millimetres of river height as well as a multiplier.

***On-line Help***

| | |
|---|---|
| RVI? ↩ | |
| River Increment: | Defines the change in river height that constitutes the recorded river height event. River height sensor resolution in feet times the recording multiplier |
| Syntax: RVI<CR> | Displays the river inc parameter |
| RVI=0.01/05<CR> | Sets river height sensor resolution to 0.01′ & a mult of 5 => a river change of 0.05′ = 1 event |

The "River Height Reference" (RVHR) is the height from which the river height data is referenced. (ie. The river height as read from a staff gauge during routine calibration)

***On-line Help***

| | |
|---|---|
| RVHR? | |
| River Height Reference: | Ref height as set during calibration or routine maint when using quadrature transducer, or offset added to 4-20mA transducer level. |
| Syntax: RvHR<CR> | Displays the river height ref level |
| RvHR=006.00<CR> | Sets river height ref to 6′ |

## 4.1.12 River Parameters 4-20mA (RVCHID, RVI, RVHR, TXR,TXI)

The "River Channel ID" (RVCHID) is a 7 digit user definable number that should be set to uniquely set to identify the river channel.

***On-line Help***

| | |
|---|---|
| RVCHID? ↩ | |
| River Channel ID: | Fixed length 7 digit numeric field |
| Syntax: RVCHID<CR> | Display river ch ID |
| RVCHID=0567890<CR> | Sets RVCHID to 0567890 |

The analog 4-20mA pressure transducer that measures river depth connects to the RRDL-3 logger through a smart sensor interface. Zero depth is represented by 4mA and maximum depth is represented by 20mA. The "Transducer Reference" (TXR) parameter defines the 20mA depth expressed in metres of water.

***On-line Help***

| | |
|---|---|
| TXR? ↩ | |
| Transducer Reference: | Defines the 4-20mA transducer max depth (What 20mA represents in terms of metres of water) |
| Syntax: TxR<CR> | Displays transducer ref |
| TxR=030.0<CR> | Sets transducer range to 030.0′ when transducer at max |

The "Transducer Interval" (TXI) parameter defines the frequency that analog measurements are made as well as the time that the transducer is powered before a measurement is made.

***On-line Help***

| | |
|---|---|
| TXI? ↩ | |
| Transducer Interval: | Defines the pressure transducer interval between measurements (mins) and power up settling time (secs) |
| Syntax: TxI<CR> | Displays the transducer intervals |
| TxI=10/5<CR> | Set to measure transducer every 10 minutes and leave transducer powered for 5 secs before measuring |

The "River Increment" (RVI) parameter changes its meaning from the quadrature transducer and now defines the river height recording resolution expressed in millimetres. The two parts of the parameter are simply multiplied to give the required resolution. This can be used to provide filtering when a sensor is sensitive or wave motion affects the reading.

***On-line Help***

| | |
|---|---|
| RVI? ↩ | |
| River Increment: | Defines the change in river height that constitutes the recorded river height event. River height sensor resolution in feet times the recording multiplier |
| Syntax: RVI<CR> | Displays the river inc parameter |
| RVI=0.01/05<CR> | Sets river height sensor resolution to 0.01′ & a multiplier of 5 => a river height change of 0.05′ = 1 event |

The "River Height Reference" (RVHR) also changes its meaning from when used with a quadrature transducer and now is an offset that is added to the river height as measured by the transducer alone.

***On-line Help***

| | |
|---|---|
| RVHR? ↩ | |
| River Height Reference: | Ref height as set during calibration or routine maint when using quadrature transducer, or offset added to 4-20mA transducer level. |
| Syntax: RvHR<CR> | Displays the river height reference level |
| RvHR=006.00<CR> | Sets river height ref to 6′ |

## 4.1.13 Status (ST, COM, R, RV)

### 4.1.13.1 The Status Window (ST)

The Status Window returns a summary of station set-up details together with a report of current rainfall and river conditions on user command. Each set-up parameter is identified by name followed by its unique command keyword, (parameter abbreviation). The Status window provides a 'plain English' response for visual interpretation as displayed on a standard computer terminal when the ST command is issued.

***Command Example***

```
ST
Site(SI):                    SYDNEY     Rain Log Start:
Date(D):                     08/29/00   River Log Start:                08/29/00
Time(T):                     13:04:29   Rain Channel ID(RChID):
Time Offset(TO):             00.00      River Channel ID(RvChID):       08/29/00
LoggerID(ID):                HS1362     Rainfall Alarm 1(RAl1):                0000001
Alarms(AL):                  Off        Rainfall Alarm 2(RAl2):                0000002
Mode rain Only(MO):          Off        Rainfall Alarm 3(RAl3):                10.00
Event Output(Ev):            On         River Alm 1(RvAl1):                    10.00/02:00
Logging On/Off(Log):         On         River Alm 2(RvAl2):                    10.00/00:30
Rain Inc.(RI):               0.01/01    River Alm 3(RvAl3):                    010.00
River Inc.(RVI):             0.01/01    River Height Ref.(RvHR):               020.00
Battery Volt(BV):            9.0V       Transducer Ref(TxR):                   005.00/02:00/010.00
Go to sleep after {S15}:     5 min      Transducer Int(TxI):                   000.00
Memory Wrap(MW):             On         RainfallEventsLeft (approx):           030.0
-------------------------------------------------------------------------------99/1
                                                                               MEM WRAP

Rain      Since     Last 10   River     Trend/          24 hr     Time    Date
Tot       09        min       Height    Interval        max
0.00″     0.00″     0.00″     0.00″     0.00″/30min     0.00″     12:25   08/29/00
```

**The River Height Trend Parameter (RvHt)**

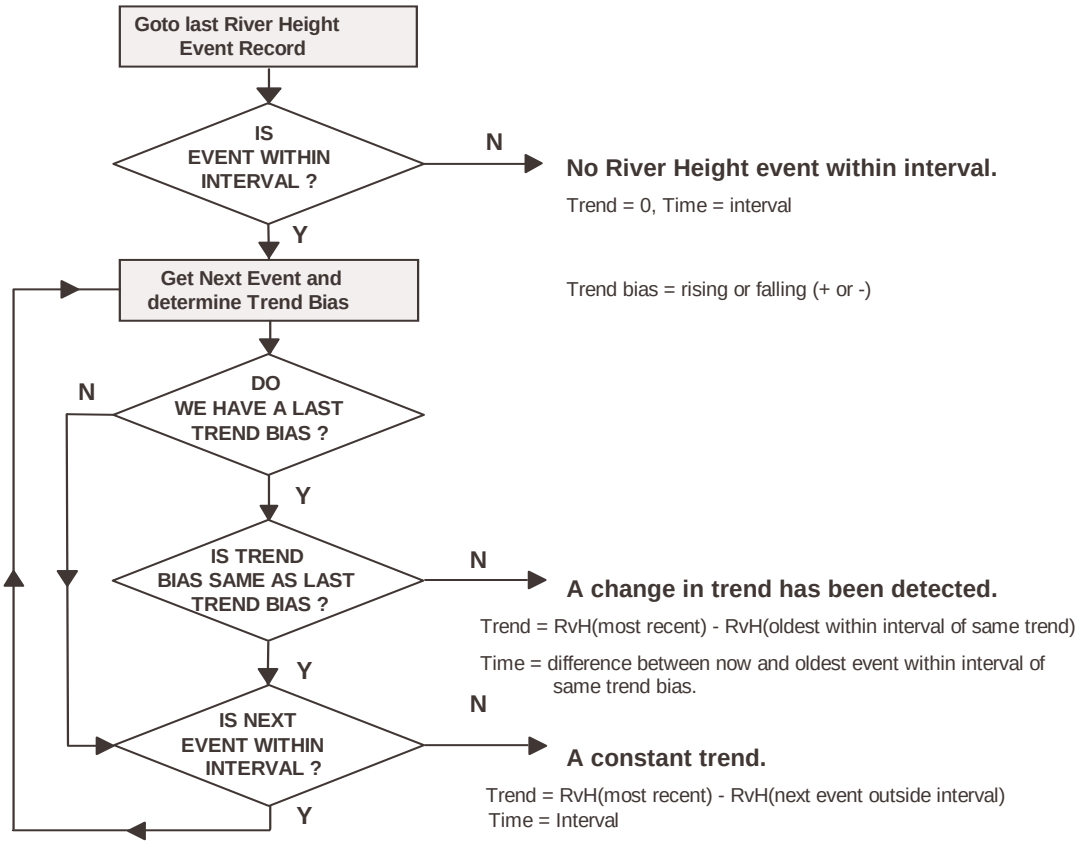
The river height trend will normally be calculated over a 30 minute time interval with a threshold equivalent to the resolution of the river height recording increment.

Definitions: River Height trend (RvHt) = sign and magnitude of the trend (feet) per time interval (min), Trend value / Trend time ( -01.44/30 ). Trend Bias = sign of the difference between two sequential events, rising or falling, + or -. Interval = time interval over which the trend is calculated.

Rules:
1. The river height trend parameter, (RvHt), is calculated on request of a newly formatted message or as the result of an alarm.
2. The river height at the time of a message request is that of the most recent event within the river height record. The river height at the time interval

boundary is that of the next event outside the interval.

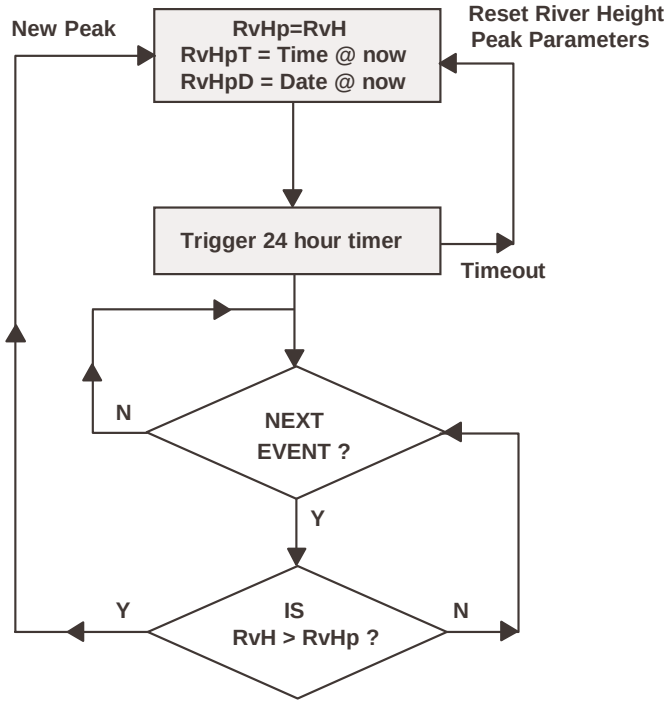
3. The Trend value = the most recent event within the time interval prior to now, minus the oldest event within that time interval of the same trend bias.
4. The Trend time = default time interval, unless a change of trend bias is detected within the interval then, Trend time = difference between now and the event time of the oldest event of same bias within the trend time window.


Goto last River Height Event Record
IS EVENT WITHIN INTERVAL ?
N
No River Height event within interval.
Trend = 0, Time = interval
Y
Get Next Event and determine Trend Bias
Trend bias = rising or falling (+ or -)
DO WE HAVE A LAST TREND BIAS ?
N
Y
IS TREND BIAS SAME AS LAST TREND BIAS ?
N
A change in trend has been detected.
Trend = RvH(most recent) - RvH(oldest within interval of same trend)
Time = difference between now and oldest event within interval of same trend bias.
Y
IS NEXT EVENT WITHIN INTERVAL ?
N
A constant trend.
Trend = RvH(most recent) - RvH(next event outside interval)
Time = Interval
Y

## The River Height Peak (RvHp)

The river height peak will be checked every river height event against the previously recorded peak (maximum). For a steadily rising river, the peak parameters (RvHp, RvHpT & RvHpD) will update each event increment until such time where the river height ceases to rise. The peak parameters will then be maintained for a period of 24 hours unless a new peak occurs, after which time RvHp, RvHpT and RvHpD will reset and take on the present values of River Height, Time and Date.

The following flow chart identifies the program logic to determine river height peak parameters.




River Height peak (RvHp) = present River Height

River Height peak Time (RvHpT) = present Time

River Height peak Date (RvHpD) = present Date

24 hour timer re-triggered every new peak or timeout to reset peak parameters.

Wait for next River Height event.

Check if River Height (RvH) is greater than River Height peak (RvHp), if true then new peak.

## 4.1.13.2 The Communications Window (COM)

The Communication Window returns a summary of communication set-up details on user command. Communication dialogue commands and responses, can be entered into the logger *Call* and *Clear* fields to permit dialogue between the data logger and an external communication device, for example, telephone modem, radio modem etc. This feature allows the data logger to establish a call, pass the message, then clear the call via a variety of communication media. The example below shows the communication dialogue for connection to a PSTN modem. The *Call Number* fields permit entry of up to three host connection numbers for receipt of messages. In the example below, a message would be automatically sent to both CN1 and CN2 destinations. Message scheduling allows user programming of time scheduled message transmission, SEND=09/5/1, instructs the logger to send a rainfall and river message at 09 hours from midnight with a 5 minute offset, once per 24 hours. (ie transmit messages at 0905 daily, data collected at 0900).

***Command Example***

| | | | |
|---|---|---|---|
| COM ↵ | | | |
| Site(SI): | MELB | LoggerID(ID): | HS0012 |
| Date(D): | 03/29/94 | Baud Rate {S1-1,S1-2}: | 9600 |
| Time(T): | 03:09:03 | Bits/parity/stop {S1-7}: | 8/N/1 |
| Time Offset(TO): | 00:00 | Handshake {S1-3,S1-4}: | Xon/Xoff |
| Call Number 1(CN1): | 036694154 | Response On/Off(Re): | On |
| Call Number 2(CN2): | 036694158 | Communication retries(RETRY): | 3 |
| Call Number 3(CN3): | | Message Scheduling (SEND): | 09/5/01 |
| Call1: | +++~~~ATQ0^M/^M^JOK | Clear1: | ~~+++~~~~ATQ0H^M^M^JOK |
| Call2: | ~~ATDT"N"^M/^M^JCO | Clear2: | ~~ATQ1^M~~~ |
| Call3: | | Clear3: | |
| Call4: | | Clear4: | |

### 4.1.13.3 The Rainfall Message (R)

The following data format represents the standard rainfall message as generated under alarm conditions, message schedule, or by command request.

ZCZC HYDR MELB 0012345 HS0001 09:23 05/01/92 0.24 0.09 1.05 0584.4 13.6 1.00 0.80/02:30 2.00/12:00 000 023 105 469 NNNN<crlf >

Note: Message terminates with <crlf>, carriage return, line feed marker.

| Par. | Parameter Definition | Sample |
|---|---|---|
| SoM | Start of Message marker, fixed field. | ZCZC |
| MsgID | Message Identifier for a rainfall message, fixed field. | HYDR |
| Site | Site Name, variable length, ( maximum of 16 characters, user programmable). | MELB |
| RChID | Rainfall Channel Identification number or Observational Station Number, (7 digits, user programmable). | 0012345 |
| LogID | Logger Identification number as hard coded by manufacturer, (6 digits). | HS0001 |
| Time | Time, (Hour:Minute format). [can be local or UTC] | 09:23 |
| Date | Date, (Month/Day/Year format). [can be local or UTC] | 05/01/92 |
| R9 | Accumulated rainfall since last 0900, (inch). | 0.24″ |
| R10 | Rainfall total during last 10 minutes, (inch). | 0.09″ |
| R24 | 24 hour rainfall total prior to last 0900, i.e. yesterday's rainfall total, (inch. 0900 to 0900) | 1.05″ |
| R | Total accumulated rainfall from last reset, (inch). | 23.00″ |
| BV | Battery Voltage, (volts). | 13.6 v |
| RAl1 | Rainfall Alarm1, rainfall since 0900 greater than user defined value, (mm, user programmable). | 1.00 - If R9 > 1.00″ then Alarm1 |
| RAl2 | Rainfall Alarm2, rainfall amount per time interval. (inch/Hr:Min, user programmable). | 0.80/02:30 - If rainfall > 0.80″ over the last 2 hours & 30 minutes then Alarm2. |
| RAl3 | Rainfall Alarm3, rainfall amount per time interval. (inch/Hr:min, user programmable) | 2.00/12:00 - If rainfall > 2.00″ over the last 12 hours then Alarm3. |
| RAlS | Rainfall Alarm Status, indicator group to identify alarm condition. An individual alarm is represented by its position within the indicator group, (three,two,one = 000). | 000 = no alarms active.<br>001 = rainfall Alarm1 active.<br>011 = Alarm1 & Alarm2 active. |
| MN | Message Number incremental message counter, (roll over at 999 then 001). | 023 |
| CC | Character Count, total number of characters in the data line excluding < crlf >, SoM and EoM. | 105 |
| CS | Check Sum, last three digits of the sum of all ASCII characters in the data line excluding < crlf >, SoM and EoM. | 469 |
| EoM | End of Message marker, fixed field. | NNNN |

### 4.1.13.4 The River Height Message (RV)

The following data format represents the standard river height message as generated under alarm conditions, message schedule, or by command request.

ZCZC HYDH MELB 0567890 HS0001 09:35 01/05/92 24.00 -4.72/30 31.73 22:15 15/02/92 13.6 22.95 32.78 9.83/02:30/18.03 000 019 115 567 NNNN<crlf >

Note: Message terminates with <crlf>, carriage return, line feed marker.

| Par. | Parameter Definition | Sample |
|---|---|---|
| SoM | Start of Message marker, fixed field. | ZCZC |
| MsgID | Message Identifier for a river height message, fixed field. | HYDH |
| Site | Site Name, variable length, ( maximum of 16 characters, user programmable). | MELB |
| RvChID | River Channel Identification number or Observational Station Number, (7 digits, user programmable). | 0567890 |
| LogID | Logger Identification number as hard coded by manufacturer, (6 digits). | HS0001 |
| Time | Time,(Hour:Minute format).[can be local or UTC] | 09:35 |
| Date | Date,(Month,Day,Year format).[can be local or UTC] | 05/01/92 |
| RvH | Present River Height (feet). | 24.00′ |
| RvHt | River Height trend, change in river height per time interval, (feet/minutes). | -4.72/30 - fall in river height of 4.72 feet over the last 30 minutes. |
| RvMax | Last River Height Max over last 24 hours, (feet). | 31.73′ |
| RvMaxT | Time of last River Height max, (Hour:minute format). | 22:15 |
| RvMaxD | Date of last River Height max, (Month/Day/Year format). | 02/15/92 |
| BV | Battery Voltage, (volts). | 13.6 v |
| RvAl1 | River Alarm1, river height threshold, (feet, user programmable). | 22.95 - If RvH > 22.95′ then Alarm1. |
| RvAl2 | River Alarm2, second river height threshold, (feet, user programmable). | 32.78 - If RvH > 32.78′ then Alarm2. |
| RvAl3 | River Alarm3, absolute change in river height over a fixed time interval and only tested above a defined threshold, (feet/Hr:Min/feet, user programmable). | 9.83/02:30/05.50 - If RvH over the last 2hr & 30min has changed by > 9.83′ providing RvH 18.03′ then Alarm3. |
| RvAlS | River Alarm Status, indicator group to identify alarm condition. An individual alarm is represented by its position within the indicator group, (three,two,one = 000). | 000 = no alarms active.<br>001 = rainfall Alarm1 active.<br>011 = Alarm1 & Alarm2 active. |
| MN | Message Number incremental message counter, (roll over at 999 then 001). | 019 |
| CC | Character Count, total number of characters in the data line excluding < crlf >, SoM and EoM. | 115 |
| CS | Check Sum, last three digits of the sum of all ASCII characters in the data line excluding < crlf >, SoM and EoM | 567 |
| EoM | End of Message marker, fixed field. | NNNN |

#### 4.1.13.5 Water Level (WL)

The "Water Level" command (WL) displays the present water level if in quadrature transducer mode, or takes a 4-20mA transducer reading if configured. The level is displayed to 2 decimal places and expressed in metres for quadrature, and 3 decimal places and expressed in metres for 4/20mA transducer.

***On-line Help***

| | |
|---|---|
| WL? | |
| Water Level: | Reads the present water level |
| Syntax: WL<CR> | |
| 000.00′ | |

## 4.2 Data Output Format

### 4.2.1 Rainfall Record

The following data represents the historical rainfall record as output from an RRDL-3 data logger. The example below represents a data record as presented to a computer after invoking an ASCII DUMP command. A HEX DUMP format (memory image) is also available where rapid dumping is essential. A convert program running from a PC environment will then reconstruct the record to its ASCII format. Each parameter is separated by a 'space' character with each line terminating with a carriage return line feed marker, (< crlf >). Additional housekeeping events, identified as 'plain English' text fields, are automatically logged to the record on the instance of a variety of events. The text fields, Record Clear, Connect, Disconnect and Record End are examples of some of the text event indicators.

| | | |
|---|---|---|
| **Station Set-up Header** | ➜ | **MELB 0012345 HS0001 0.2< crlf >** |
| **Logger Start Header** | ➜ | **09:35:23 4/24/94 0 Record Clear< crlf >** |
| **TBRG Connect** | ➜ | **10:20:23 4/24/94 0 Connect< crlf >** |
| | | **10:25:37< crlf >** |
| **Rainfall Event** | ➜ | **10:27:42< crlf >** |
| | | **16:53:05< crlf >** |
| **Daily Summary** | ➜ | **00:00:00 4/25/94 3< crlf >** |
| | | **15:43:09< crlf >** |
| | | **15:44:23< crlf >** |
| | | **15:45:00< crlf >** |
| | | **22:22:55< crlf >** |
| | | **00:00:00 4/26/94 4< crlf >** |
| | | **22:24:00< crlf >** |
| **TBRG Disconnect** | ➜ | **10:25:37 4/26/94 1 Disconnect< crlf >** |
| | | **00:00:00 4/27/94 0< crlf >** |
| **End of Record Marker** | ➜ | **Record End** |

| Field | Par. | Parameter Definition |
|---|---|---|
| Station Set-up Header | MELB<br>0012345<br><br>HS0001<br><br><br>0.01 | Site Name, variable length, user programmable.<br>Channel ID Number or observational site number, 7 digits, user programmable.<br>Logger ID, 6 digits, hard coded by manufacturer, where first two digits "HS" represent an alpha manufacturer ID followed by a four digit unit number.<br>Rainfall recording Increment, 0.01 inch, user programmable. |
| Logger Start Header | 09:35:23<br>4/24/94<br>0<br>Record Clear | Logger Start Time, Hour:Minute:Second.<br>Logger Start Date, Month/Day/Year.<br>Start Count, event accumulator, 0 counts.<br>Indicator to identify start event, normally "Record Clear". |
| TBRG Connect | 10:20:23<br>4/24/94<br>0<br>Connect | Rain Gauge Connect Time, Hour:Minute:Second.<br>Rain Gauge Connect Date, Month/Day/Year.<br>Connect Count, event accumulator, 0 counts.<br>Indicator to identify TBRG Connect, triggered by insertion of connector. |
| Rainfall Event | 10:27:42 | Time Stamp of contact closure, Hour:Minute:Second. |
| Daily Summary | 00:00:00<br>4/25/94<br>3 | Time Stamp check at zero hours, Hour:Minute:Second.<br>Date Stamp check at zero hours, Month/Day/Year.<br>Daily event accumulator, (daily total = 3 counts). |
| TBRG Disconnect | 10:25:37<br>4/26/94<br>1<br>Disconnect | Rain Gauge Disconnect Time, Hour:Minute:Second.<br>Rain Gauge Disconnect Date, Month/Day/Year.<br>Disconnect Count, event accumulator, 1 count.<br>Indicator to identify TBRG Disconnected, triggered by removal of connector. |
| End of Record Marker | Record End | Indicator to identify the end of the rainfall record. |

## 4.2.2 River Height Record

The following data represents the historical river height record as output from an RRDL-3 data logger. The example below represents a data record as presented to a computer after invoking an ASCII DUMP command. A HEX DUMP format (memory image) is also available where rapid dumping is essential. A convert program running from a PC environment will then reconstruct the record to its ASCII format. Each parameter is separated by a ‘space’ character with each line terminating with a carriage return line feed marker, (< crlf >). Additional housekeeping events, identified as ‘plain English’ text fields, are automatically logged to the record on the instance of a variety of events. The text fields, Record Clear, Logging Disabled, Logging Enabled and Record End are examples of some of the text event indicators. NOTE: In the combined rainfall and river mode of operation, the logger does not generate the Connect and Disconnect messages.

**Station Set-up Header** ➜ **MELB 0567890 XX0001 150< crlf >**
**Logger Start Header** ➜ **09:35:23 4/24/94 23.93 Record Clear< crlf >**
**10:20:23 24.43< crlf >**
**11:25:37 24.92< crlf >**
**River Height Event** ➜ **13:25:45 25.41< crlf >**
**15:33:05 24.92< crlf >**
**Daily Summary** ➜ **00:00:00 4/25/94 24.92< crlf >**
**02:27:55 24.43< crlf >**
**03:28:05 23.93< crlf >**
**15:45:00 23.44< crlf >**
**16:20:12 22.95< crlf >**
**16:39:19 4/25/94 22.95 Logging Disabled< crlf >**
**16:54:48 4/25/94 22.95 Logging Enabled< crlf >**
**22:22:55 23.44< crlf >**
**00:00:00 4/26/94 23.44< crlf >**
**00:00:00 4/27/94 23.44< crlf >**
**End of Record Marker** ➜ **Record End**

| Field | Par. | Parameter Definition |
|---|---|---|
| Station Set-up Header | MELB<br>0567890<br><br>HS0001<br><br><br>5.9 | Site Name, variable length, user programmable.<br>Channel ID Number or observational site number, 7 digits, user programmable.<br>Logger ID, 6 digits, hard coded by manufacturer, where first two digits "HS" represent an alpha manufacturer ID followed by a four digit unit number.<br>River Height recording Increment, 5.9 inch, actual value of the increment represented by the time stamp, user programmable. |
| Logger Start Header | 09:35:23<br>4/24/94<br>23.93<br>Record Clear | Logger Start Time, Hour:Minute:Second.<br>Logger Start Date, Month/Day/Year.<br>River Start Height, 23.93′.<br>Indicator to identify start event, normally "Record Clear" or "Power On". |
| River Height Event | 13:25:45<br>25.41 | Time Stamp absolute change in river height by 150mm.<br>River Height, 25.41′. |
| Logging Disabled | 16:39:19<br>4/25/94<br>22.95<br>Logging Disabled | Logging Disabled Time, Hour:Minute:Second.<br>Logging Disabled Date, Month/Day/Year.<br>River Height at Logging Disable Time<br>Indicator to identify Logging disabled, triggered by "log=off" command. |
| Daily Summary | 00:00:00<br>4/25/94<br>24.92 | Time Stamp check at zero hours, Hour:Minute:Second.<br>Date Stamp check at zero hours, Day/Month/Year.<br>River Height at zero hours, 24.92′.(last event). |
| End of Record Marker | Record End | Indicator to identify the end of the river height record. |

# 5. Specification

## 5.1 Hardware Specification

### 5.1.1. General

| | |
|---|---|
| Microprocessor | Intel 80C196 |
| Program Memory | AMD29F010 128KB Flash EPROM (PLCC28)<br>(64KB Available for program) |
| Data Memory (On board) | AMD29F010 128KB Flash EPROM (PLCC28)<br>(Min of 100,000 erase/write cycles) |
| Parameter Memory | PCF8594 512 Bytes EEPROM (SO8)<br>(Min of 100,000 erase/write cycles) |
| Events Recorded | 1 second resolution.<br>2 bytes per event.<br>Typical 112KB -> 52,000 events total<br>(includes overheads for 1 year)<br>(Memory partitions give rain and<br>river event splits as follows :-<br>39,000 rain events max +15,600 river events,<br>through to<br>15,600 rain events + 39,000 river events max) |
| Real Time Clock | Day/Month/Year Hour/Minute/Second<br>Battery backed with Lithium Cell<br>32768 Hz crystal trimmable<br>Accuracy approx. 20 secs per month<br>Programmable alarm wakeup. |
| Inputs | 1 x Digital rain gauge input<br>1 x Digital quadrature shaft encoder input<br>Optically Isolated expansion port for<br>smart sensors > 4-20mA, 0-5v etc... |
| Outputs | 1 x O.C. output for sensor control<br>1 x Batt. switched output for modem power |
| Indicators | LED indicator to show a change has<br>been recognised / logged. |
| Communications | RS232 Port (Tx, Rx, DTR and CD)<br>Hardware handshake or Xon/Xoff.<br>Mini modem power control. |

| | |
|---|---|
| Power Supply | 6V to 14V DC unregulated.<br>75mA operating mode 200uA sleep mode. |
| Transient Protection | Each input protected to 500V DC<br>at 20 Joules w.r.t 0V. |
| PCB Dimensions | 2.8″ x 4″ |
| RRDL-3 Box Dimensions | 4.7″ x 3″x 2.7″ |
| Weight | Less than 1 lb (Including internal batteries) |
| Help | Unique on board help system to give available commands as well as individual command description and syntax. |

### 5.1.2 Rainfall Sensor Interface

The standard RRDL-3 logger includes a digital tipping bucket rain gauge (TBRG) interface. The occurrence of a user defined rainfall event causes the logger to wake momentarily, record the event to the historical record, transmit the event on the serial port (if the EV flag is on), update the rainfall since 09:00 and check for the 3 types of rainfall alarm before going back to sleep.

### 5.1.3 River Height Sensor Interface

The standard RRDL-3 logger includes a digital river height interface for connection to a quadrature shaft encoder. A separate analog interface has been developed for connection with pressure transducers and other 4 to 20 mA sensing equipment. The complete interface will be contained in the same box as the standard RRDL-3 unit with all connections made via the sensor connector port. The standard RRDL-3 software load supports 4 to 20 mA sensing with specific set-up parameters included to configure an analog system.

In a digital river system (shaft encoder), the occurrence of a user defined river height event causes the logger to wake momentarily and record the event to the historical record, transmit the event on the serial port (if the EV flag is on), check for river peak, update river trends, check for the 3 type of river alarm before going back to sleep. In an analog system, the sensing device requires power to operate, therefore, to theoretically capture every event, the sensing unit would require continuous power. Since this is not practical due to power requirements, a quasi event recording mechanism for analog recording has been implemented. The logger wakes every minute to power the sensing device, allow for settling time, take a measurement and return to sleep mode. If the measurement is different from the last logged value by more than the defined river increment, then the new measurement is logged.

### 5.1.4 Communications Interface

The communications interface is very powerful and flexible, allowing for simple direct connection to a PC through to modem connection and automatic dialling into and through a computer network and dumping data onto a computer. The hardware interface is standard RS232, and various software flags and parameters allow for the flexible operation. The logger can be woken up remotely either by reception of Rx data or by assertion of carrier detect (DCD). Four baud rates can be selected as well as hardware or Xon/Xoff handshaking.

### 5.1.5 Watchdog

The logger incorporates 'watchdog' circuitry within the microprocessor to automatically recover from unforeseen software or noise indued failures. The action of a watchdog reset does not affect previously recorded data or any set-up parameters including date and time.

### 5.1.6 Power Supply / Power Consumption

It is recommended to power the logger with one external 12 volt battery. Minimum voltage 11Vdc, Maximum voltage 14Vdc.

To conserve power, the logger normally functions in a 'sleep' mode. On receipt of an **event** the logger 'wakes up' and performs the appropriate program tasks before returning to 'sleep'. An event is considered a contact closure, a communication input or a timer wakeup.

Hardware design facilitates simple battery replacement and protection against polarity reversal. A separate battery compartment protects the logger electronics against possible battery leakage.

Power consumption calculations are specific to a Hydrological Services RRDL-3 logger and DataPlex PSTN DPX-213 Hayes compatible modem.

| **Mode** | **RRDL-3** | **DPX-213** | **Total** |
|---|---|---|---|
| Operating | 75 mA | 80 mA | **155 mA** |
| Sleep | 200 uA | Nil | **200 uA** |

Calculations are based on the following :-

- 24 interrogations daily, at 60 second call duration.
- The DPX-213 operating mode is with front panel led indicators off and wake on ring detect.
- 24 calls X 60 secs = **1440 secs**, therefore current drain = **155 mA** for **1440 secs**

- 24 Hrs X 60 min X 60 secs = **86400 secs**, therefore current drain = **200 uA** for **86400secs - 1440 secs**
- 1440/86400 = 0.0167 or 1.67% (1.7%), therefore **1.7%** @ **155 mA** and **98.3%** @ **200 uA**

- average current drain = [(1.7% X 155 mA )+ (98.3% x 200 uA)] 100 = **2.83 mA** continuous
- Power = 12 v (nominal supply) X 2.83 mA = **34 mW**

Notes:

1. For an RRDL-3 connected to a TBRG and Shaft encoder, each rain, river or 6 Hr internal housekeeping event, wakes the logger for approximately 20 mS at 75 mA current drain. With 100 events daily, the added power consumption is negligible, approximately 2 Mw.
2. A 1AH battery could provide sufficient energy to run the station for 350 hours or 2 weeks without recharge.
3. The battery, modem, and logger could fit within the internal dimensions of a TBRG. The external surface area of the TBRG could house a flexible solar array of sufficient capacity to charge the internal battery.
4. The dial out capability of the logger will increase power consumption when compared to polling for the same data. This is due to the logger and modem consuming power during the call set-up and clear sequence.

### 5.1.7 System Memory

A fundamental requirement of the logger unit is for sufficient memory capacity to store 45,000 events, time stamped to one second resolution, plus the additional overheads of periodic time and date checks. The figure of 45,000 is representative of 9.5 metres of rainfall where each event equals 0.2 millimetres, and satisfies the maximum expected annual rainfall for a location within Australia.

In most cases the logger unit can be returned to the processing centre via surface mail. The loggers small size and light weight means the package returned, conforms with low cost postage tariffs.

The logger application requires three essential memory areas, **Data Memory** for storage of the historical records, **Program Memory** for storage of the application software and **Set-up Memory** to store unique station parameters.

The memory arrangement is as follows:-

- **Data Memory** - re-usable, non-volatile Flash memory (100,000 write / erase cycles);

- **Program Memory** - the application software is also contained in Flash memory which allows for the unique feature of downloading new software remotely;

  Set-up Memory - **$E^2$PROM for storage of user set-up parameters with 100,000 write / erase cycles**.

### 5.1.8 System Clock

The clock performance in terms of reliability and maintainable accuracy is of prime importance as the historical rainfall record is unusable should time and date errors occur. The clock maintains

an accuracy of better than 30 seconds per month with resolution to one second across an operating temperature range from -10°C to +70°C.

### 5.1.9 Logger Identification

Each logger has a six digit unique identification number hard coded and accessible as a **read** only system parameter via software.

### 5.1.10 Start-up Indicator

The periodic removal and replacement of the logger to facilitate data processing, may be performed by unskilled personnel without the aid of computer equipment to verify operation. On power up of a replacement logger, as well as when an **event** occurs a visual indicator (LED flash) confirms successful operation. This LED flashes 4 times on power-up, 3 times when a TBRG connect occurs and 2 times when a TBRG disconnect occurs. (See section 3.1.1. and section 4.2.1. for connect / disconnect information)

### 5.1.11 Transient, EMI, RFI Protection

The RRDL-3 logger passes the following tests :-

- **Transient** - withstands at least 10 transient pulses, with each pulse having a nominal energy of 20 Joules and a peak positive or negative voltage of 500 volts, between the ground reference and each conductor that enters the logger.

- **EMI** - exposure to DC and 50/60 cycle, 200 gauss magnetic field operated at any position around the logger to a minimum distance of 1 metre.

- **RFI** - exposure to a continuous and pulsed AM and FM transmitter, with and without modulation, that is operated in close proximity to the logger unit. ( e.g. a 5 watt transmitter directly adjacent and a 60 watt transmitter operating to a minimum distance of 1 metre).

# 6. Fault Finding

This fault finding guide should be used by the RRDL-3 user before they consult the manufacturer to assist with specific problems.

***No response on power up (LED does not flash).***

- Remove and check the voltage of each AA cell battery. (should be 1.5V, absolute minimum 1.2V) Try replacing batteries!
- Check the orientation of each battery in the battery holder. (-ve end of the battery to the spring connector).
- If LED indicator does not flash 4 times when the batteries are inserted, check the connectors that plug onto the logger circuit board are pushed on firmly.
- If LED still does not flash after the above has been checked, return the logger to the supplier for service.

***No communications from logger.***

- Try repowering up the logger by removing and replacing a battery.
- Check if LED flashes when sending a character to the logger. If not, see if LED flashes in response to a TBRG bucket tip. If not, check logger power up LED flash sequence.
- Check the logger baud rate, number of bits and parity match that of the terminal emulation program being used on the computer. If not, change it, and try again.
- Check the Tx, Rx and Gnd wiring to the logger from the computer.
  Check the handshake setting, and try setting to "None" or "Xon/Xoff".
- If using "Hardware handshake", check that the Carrier Detect line is high, otherwise the logger will not transmit any data.
- Check that the terminal emulation program is working, by disconnecting the logger and shorting the Tx and Rx wires together, and type on the computer. You should get each character twice on the screen.

***What I type on the computer does not appear, but the logger seems to respond OK.***

- Set the terminal emulation program "Local echo" to on.

***A TBRG bucket tip flashes the LED but nothing gets transmitted.***

- Set the event flag (EV) to on to allow events to be transmitted. However the flag should be off if the logger is connected to an intelligent modem.
- Check that the multiplier in the rain increment parameter (RI=x.x/**mm**) is set to a reasonable number. Remember that **mm** bucket tips represent one event.

***When I type <CR> (Enter ↵) on the computer the LED flashes but I get no reply.***

- Set the response flag (RE) to on. This flag is used to stop the logger responding to data from an intelligent modem. If you are talking through a modem then this is correct, you will not get a response to a <CR> (Enter ↵ ) because the response flag must be left off.

***The logger will not accept my password.***

- Check that you have the correct password, and you are entering it in the correct upper and lower case.
- If still no success, the logger must be returned to the manufacturer, to set a default password. Keep your password written down in a secure place.

***When using the connect/disconnect hardware link, I get nothing in the rain log when the connector is removed and replaced.***

- Check that the link is on the correct pins.
- Check that the logger is either in "Rain Only Mode" (MO=on) or in "Rain + River Mode" (MO=off) where the river mode is set for 4-20mA (DIP Sw 1-6 is on).
- When the connector is removed the LED should flash 2 times and when the connector is inserted the LED should flash 3 times.

***The quadrature river encoder flashes the LED but nothing gets transmitted.***

- Check that the logger is in "Rain + River Mode" (MO=off) and in quadrature mode (DIP Sw 1-6 is on).
- Set the event flag (EV) to on to allow events to be transmitted. However the flag should be off if the logger is connected to an intelligent modem.
- Check that the multiplier in the river increment parameter (RVI=xx/mm) is set to a reasonable number. Remember that mm quadrature changes represent one event.

***The logger does not remember the time if I remove the batteries.***

- The Real Time Clock lithium battery must be flat. Return the logger to the supplier to replace the lithium battery.

***When the logger goes to sleep or I type BYE, I get a strange message.***

- The logger is designed to hang up a modem and clear it to a known state when going to sleep. This is performed with the CLEAR sequence. Check the CLEAR sequences by using the comms window (COM). The sequences can be nulled by entering CLEAR1=↵ , CLEAR2=↵ etc.

***Periodically I get funny characters displayed (Modem not connected).***

- The logger may be attempting to send either a scheduled message or an alarm message. Check the CALL and CLEAR sequences by using the comms window (COM) to check communication settings. The sequences can be nulled by entering CLEAR1=↵, CLEAR2= ↵ etc..
- Turn off the scheduled send command by entering SEND=00/0/00.
- Turn off alarms by typing AL=off

***When I dial through on a modem and wait more than 2 seconds I don't get the "Status Window" displayed.***

- Check the logger handshake is set to Xon/Xoff.
- Check the Carrier Detect line from the modem is connected to the logger.
- Check that the Carrier Detect line goes high (+12V) when the modem answers. (When this line goes high the logger LED should flash).

***When I enter a parameter I just get a "Syntax Error" reply.***

- Check the exact command syntax by using the on-line help. Type comnd?↵ . Now re-enter the parameter with all leading and trailing zeros.

***When I enter a command I just get a "Command Error" reply.***

- Check that the command you are entering is a valid command by using the on-line help. Type ?↵ and check the exact spelling of the command.

***The batteries don't last 1 year.***

- The logger is designed for 1 year operation when logging rain data standalone. Ensure that alarms are turned off (AL=off) otherwise the logger will wake on an alarm and try to communicate with a modem and possibly wait in a powered up state between retries. Also ensure that the scheduled send command is off (SEND=00/0/00) so agin the logger doesn't repeatedly try to talk to a modem.
- If the logger is connected to a modem for alarm and scheduled messages, you will not get 1 year life from the batteries. External batteries and/or a solar array should be used to power the logger.
- Excessive activity on a river quadrature sensor (tidal river) could also cause the batteries to go flat quicker than normal.
- Ensure that after a communication session with the logger you use the BYE command to force the logger back to sleep, rather than let the 1 or 5 minute timeout cause the logger to go to sleep, as the battery power is considerably drained during this 1 or 5 minute period. Keep the communication sessions to a minimum to conserve power.
- The logger should spend most of its life asleep. In this mode the logger consumes about 200uA. This can be checked by removing one battery, (ensure remaining batteries have full capacity to power the logger) and using a digital ammeter short out where the removed battery came from. When the logger powers up (LED flashes 4 times) it should consume about 75mA. Force the logger to sleep by typing the BYE command, the logger should now consume about 200uA.

**APPENDIX A**

# RRDL-3 'COMLOG'
# COMMUNICATIONS SOFTWARE
# OPERATION MANUAL - IMP
# PART NO. DL312 1000

HYDROLOGICAL SERVICES Pty Ltd
48-50 Scrivener Street
Liverpool NSW 2170
Australia
Ph. 61 2 9601 2022 Fax. 61 2 9602 6971
E-Mail sales@hydrologicalservices.com

# Table of Contents


| | | Page |
|---|---|---|
| 1. | Introduction | DL312 100-03 IMP |
| 2. | Hardware Connection | DL312 100-03 IMP |
| 3. | Software Installation | DL312 100-04 IMP |
| 4. | Starting and Configuring the Software | DL312 100-04 IMP |
| 5. | Saving data to a file | DL312 100-05 IMP |
| 6. | Saving logger output in Spreadsheet format | DL312 100-06 IMP |
| 7. | Exiting the program | DL312 100-06 IMP |

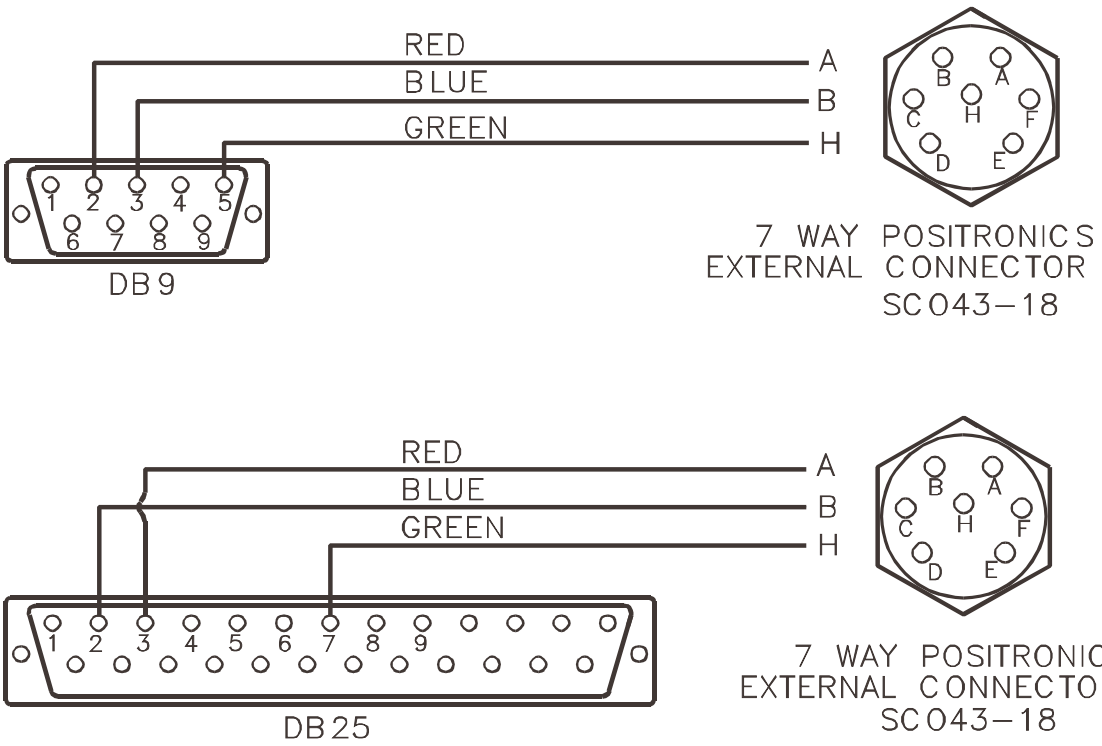
# 1. Introduction

This software package has been specifically written to communicate to the Hydrological Services Rain and River Data Logger RRDL-3. The program itself is a simple terminal emulation package with simple to use configuration options that match the options selectable from the RRDL-3 Data Logger. These options include computer COM port selection (COM1 or COM2), baud rate (300 or 1200 or 2400 or 9600), number of bit and parity (8/N/1 or 7/E/1) and handshake (None or XON/XOFF or Hardware). The software also allows the saving of all communications within a session to a user named file, for later examination. Note that this software is not tailored for modem operation.

# 2. Hardware Connection

The RRDL-3 provides three forms of handshake “None”, “XON/XOFF” or “Hardware”. The most common and widely used form of handshake is XON/XOFF. The Hardware handshake requires one extra wire between the logger and the PC. Also note that PC’s have two types of physical connection to their serial port, a DB9 plug or a DB25 plug.

***Direct connection to PC (Handshake = None or Xon/Xoff)***



| Part No. | Description | Purpose |
|---|---|---|
| DL307 | Interrogation lead - DB9 | Interrogation lead - logger to PC, DB9 Female connector |
| DL308 | Interrogation lead - DB25 | Interrogation lead - logger to PC, DB25 Female connector |
| DL309 | Lead RRDL3 to Modem | Connection lead - logger to modem, DB25 Male connector |

# 3. Software Installation

The software is installed by placing the 3.5" floppy disk in drive A: and moving to the directory on your hard disk where you require the software to reside.
Type "copy a:\comlog.exe " and the program will be copied to the hard disk. (Similarly the software can be copied from the B: drive by typing "copy b:\comlog.exe ")

# 4. Starting and Configuring the Software

The software may be run in either a DOS or Windows environment!

To start the software from DOS simply type "comlog ↵ ". The software will initially start with the default configuration of COM1, 9600 baud, 8 bits, No parity, 1 stop bit and XON/XOFF handshake. Once the software has been configured and saved, it will start up with the saved configuration. (The configuration file is called "comlog.cfg") The configuration file is saved in the directory where the application is run, therefore you may set up different configurations in different directories.

To start the software from Windows either double click on the "comlog.exe" file while in file manager or set up an icon to start the program by using the standard Windows procedure - consult Windows help.

Once the program has started press F1 for help. The following will be displayed :-

Command Summary ---> Alphanumeric keys for terminal emulation
F1 - Displays this help screen.
F2 - Toggles COM1 or COM2 ports
F3 - Toggles 9600/2400/1200/300 baud rates
F4 - Toggles 8 bits/no parity and 7 bits/even parity
F5 - Toggles Handshake None/XonXoff/Hardware
F6 - Display the present configuration + Log status
F7 - Enable/Disable Logging to a file
F8 - Enable/Disable Logger output in SPREADSHEET format to file
F10 - Save the present configuration
esc - To exit this program

Use the F2 key to select your computer COM port and use F3, F4 and F5 keys to match the configuration of your RRDL-3 logger. Once the configuration has been selected, press F10 to save it. Note that Help and configuration text will appear in “blue” on your computer screen, and data to and from the RRDL-3 logger will appear in “white”.

Note that when starting the program, the saved COM port may be over-ridden by typing “comlog 1” to force communications through COM1, or ”comlog 2” to force communications through COM2.

# 5. Saving data to a file

a) Press F7
The computer goes to ‘Data Save’ mode. The user will be prompted with:
Enter the filename you wish to save data to:

b) Enter file name
Note: If file name already exists the user will be asked:
“File exists, do you wish to over write it? (Y/N)”
If selected Y, computer prompts:
Saving data to “.....” (filename)
If selected N, computer exits from ‘Data Save’ mode. Select F7 again to go to ‘Data Save’ mode.
Once a valid file name is accepted, all communication to and from logger is saved to this file. This includes ‘Commands’ sent to logger as well as responses from the logger such as requested data. **Screen colour changes to white as soon as some character is typed.**

c) Use “ST” command to save Logger Settings in file. (If required)
Use ‘R’ command to save rain on river height message (refer pages DL3 100-35) Logger Manual).

d) Use Rain data dump command “ DUR ↩” for saving Rain data to the file. All the data transferred to file is seen on the screen.

e) Use River data dump command “DURV ↩” for saving river data to the file. All data being transferred is seen on the screen.

f) Press F7 again to terminate ‘Data Save’ mode. The computer screen colour changes back to blue.

# 6. Saving logger output in Spreadsheet format

The Rain and River dump data from a logger may be saved in Spreadsheet format by pressing F8 at the beginning of a session. The user will be prompted to enter a file name. (If the name already exists, the user will be asked if they wish to overwrite the old file) Then when a dump rain DUR or dump river DURV command is performed, the data is rearranged so that it can be read by a spreadsheet package such as Excel. The data appears in the following format :-

| **File Data** | **Comment** | |
|---|---|---|
| Sydney_0000001_HS0925_ | 0.2 | >>Logger name, ID and bucket size |
| YYMMDDHHMMSS | 0.2 | separated by '_' |
| YYMMDDHHMMSS | 0.4 | >>Logger events stamped with Year |
| YYMMDDHHMMSS | 0.6 | >>Month, Day, Hour, Minute, Second |
| YYMMDDHHMMSS | 0.8 | >>delimited by a TAB from the |
| YYMMDDHHMMSS | 1.0 | >>accumulated rainfall |
| YYMMDDHHMMSS | Logger Disconnect | >> TBRG disconnected from logger |
| YYMMDDHHMMSS | Logger Connect | |
| YYMMDDHHMMSS | 0.2 | >>Events start from 0 after Connect |
| YYMMDDHHMMSS | 0.4 | |
| YYMMDDHHMMSS | 0.6 | |
| Record_End | | >>End of Dump File |

To close the file simply press F8 again. (The file will also be closed if you exit the program.) Pressing F6 will display the current configuration as well as the file name if a session is being saved to a file.

# 7. Exiting the program

To exit the program press the "esc" key.